Digital Energy
Multilin

MultiLink
Ethernet Communications Switch
Quickstart Guide

Firmware Revision 3.x

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These instructions do not purport to cover all details or variations in equipment nor provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the General Electric Company.

To the extent required the products described herein meet applicable ANSI, IEEE, and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

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GE Multilin Multilink Quickstart Guide for revision 3.x.

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Part number: 1601-9026-A3 (July 2009)

Table of Contents

1. PREPARATION 1
- PRECAUTIONS 1
- DETERMINING MOUNTING LOCATION 1

2. MECHANICAL INSTALLATION 3
- TABLE-TOP OR SHELF MOUNTING 3
- RACK MOUNTING - ML2400 3
- DIN-RAIL / PANEL MOUNTING - ML1600 4
  - Mounting Dimensions with Metal Brackets 6
- DIN-RAIL / PANEL MOUNTING - ML1200/ML800 7
  - Mounting Dimensions for ML1200/ML800 with metal brackets 7

3. ELECTRICAL INSTALLATION 9
- POWERING THE UNIT - ML2400 9
- POWERING THE UNIT - ML1600 10
- POWERING THE UNIT - ML1200/ML800 10
- UL REQUIREMENTS FOR DC-POWERED UNITS 11
- ALARM CONTACTS 11
- DIELECTRIC STRENGTH (HI-POT) TESTING 12

4. CONNECTING A MANAGEMENT CONSOLE TERMINAL TO THE UNIT ... 13
- DESCRIPTION 13
  - ML2400/ML1600 13
  - ML1200/ML800 14

5. INTRODUCTION TO TWISTED PAIR & FIBER OPTIC ETHERNET LANS .. 15
- ETHERNET PHYSICAL LAYER: TWISTED PAIR COPPER VS FIBER OPTIC 15
  - Twisted Pair copper cable 15
  - Fiber 16
- SUPPORTED NETWORK TOPOLOGIES 16
  - Star Architecture 16
  - Mesh Architecture 16
  - Ring Architecture 17
- 10BASE T AND 100BASET MEDIA 17
  - Unshielded Twisted Pair cable: 17
  - Ethernet: Unshielded Twisted Pair 18

6. CONNECTING ETHERNET MEDIA 20
- DESCRIPTION 20
- CONNECTING ST-TYPE FIBER OPTICS (TWIST-LOCK) 20
- CONNECTING SC-TYPE FIBER OPTICS (SNAP-IN) 21
- CONNECTING SINGLE-MODE FIBER OPTICS 21
- CONNECTING RJ45 TWISTED PAIR 21
- CONNECTING GIGABIT MEDIA USING GBICS 22

7. HUBS AND SWITCHES 23
- FIBER OPTIC ETHERNET: 23
  - Wavelengths of light 23
- SINGLE AND MULTI-MODE CABLE 24
  - Fiber Cable Cross Section and Physical Specifications 24
  - Single mode fiber - Less attenuation per unit distance 25

8. OPTICAL POWER BUDGET 26
- ASSIGNING AN IP ADDRESS TO THE MULTILIN SWITCH 27
- ASSIGNING A STATIC IP ADDRESS TO A PERSONNEL COMPUTER 33
- CONFIGURING THE SWITCH PORTS FOR UR REDUNDANT OPERATION 39

9. TAGGED VLANS & RING ONLY MODE- 42
Background: 42
CONFIGURING TAGGED VLANS 42
Configuring a VLAN within the switch 43
CONFIGURING THE MULTILINK SWITCH FOR RING ONLY MODE 49
10. MULTILINK FIRMWARE UPDATES 57
UPDATING MULTILINK FIRMWARE 57
SELECTING THE PROPER VERSION 57
UPGRADING USING A SERIAL CONNECTION- COMMAND LINE INTERFACE 57
UPDATING USING THE ENERVISTA WEB INTERFACE SOFTWARE 62
Using FTP 62
Using TFTP 63

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1 Preparation

1.1 Precautions

Before installing the equipment, it is necessary to take the following precautions if the equipment is mounted in an enclosed or multiple rack assembly:

1. Ensure the environmental temperature is less than or equal to 50°C.
2. Please ensure 1U (1.75") gap is provided above each switch in the enclosure for heat dissipation.
3. Placement of the equipment must not overload or unevenly load the rack system.
4. Verify the equipment's power requirements to prevent overloading of electrical circuits.
5. Verify that the equipment has a reliable and uncompromised grounding path.
6. Equipment is to be installed by service personnel in a restricted operation area.

This chapter describes installation of the MultiLink Ethernet Switch, as well as connection of the various Ethernet media types.

1.2 Determining Mounting Location

For mounting instructions, refer to *Section 2*, below.

The location of a Unit switch is dependent on the physical layout of the network. The Unit is typically placed in a central location where groups of network devices need to communicate. These switches are typically rack mounted in a wiring closet, but because

they have rubber feet they can also be installed on a shelf or table top unit. The compact size allows the Unit to be easily placed in an office or lab area, and it can also be either shelf of wall-mounted.

Locate a power source within six feet (2 meters) of the intended Unit site. The rugged metal case will normally protect the switch from accidental damage in a lab or workplace setting. Maintain an open view of the front to visually monitor the status LEDs.

2 Mechanical Installation

2.1 Table-top or Shelf Mounting

The Unit can be mounted on a table-top or any suitable horizontal surface. It has four rubber feet to provide stability without scratching finished surfaces.

2.2 Rack Mounting - ML2400

Installation of a MultiLink Ethernet Switch in a 19-inch rack is a simple procedure. When properly installed, the front-mounted LED status indicators should be in plain view and easy to read. Rack-mount installation requires special 19-inch rack-mounted brackets and screws (included with the Unit). These brackets attach to the front sides of the switch, which is then typically fastened into a standard 19" RETMA rack as shown below.

FIGURE 1: Rack mounting

NOTE

Please ensure 1U (1.75") gap is provided above each switch in the enclosure for heat dissipation.

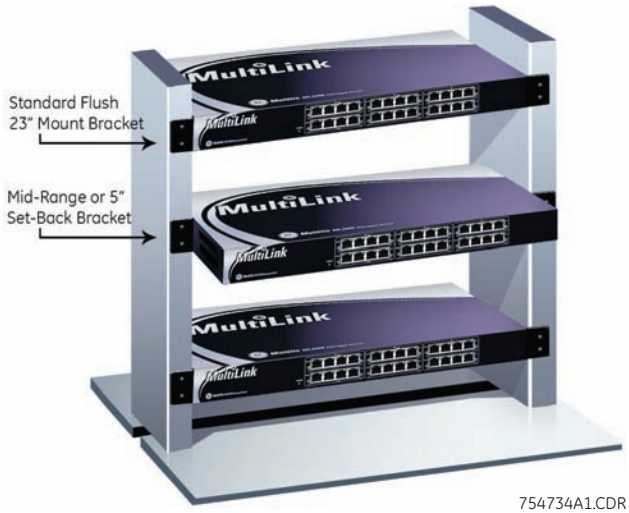

FIGURE 2: Mountings for Unit units rack-mounted in a frame

The 23-inch brackets and the ETSI (European metric, approximately 21") brackets are also available for rack-mounting of the Unit. These brackets are popular in the telecommunications industry where they are a standard for central office rack-mounting purposes. The 23-inch and the ETSI brackets are mainly used for larger equipment assemblies in rack-mounting frames where the rack-mount equipment is typically accessed in operation from both sides.

The bracket mounting holes in the sides of the Unit permits it to be mounted in various ways. The same holes fit all three types (19", ETSI, 23") of brackets. The mounting for the 23" is illustrated above. The brackets may be attached flush with the front, or attached in the center for a set-back mounting which may reduce cabling torque.

The optional 23" brackets and the ETSI (21") brackets each come as a pair in a package, along with the necessary screws for attaching the brackets to the sides of the Unit. They must be ordered as line items.

2.3 DIN-Rail / Panel Mounting - ML1600

The Unit is designed for use in a "factory floor" industrial environment. It is available with optional DIN-rail brackets to mount it securely in a metal factory floor enclosure, maintained vertically for proper convection cooling of the unit. The Unit requires two DIN-rail mounting clips or latches for secure mounting – contact GE Multilin for ordering information.

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FIGURE 3: Unit with DIN-rail clips

The DIN rail latching clips are mounted on the upper rear corners of the unit. Two threaded holes are provided on the sides of Unit for DIN-rail mounting purposes. Two #10-32 × 3/8 PHIL. PAN with star washer screws are included with the DIN-rail brackets. The two heavy duty DIN-rail latches are designed to be manually accessible from the top when the unit is installed on a DIN-rail.

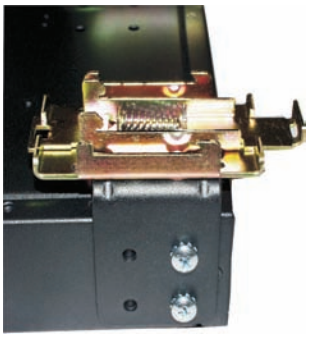

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FIGURE 4: DIN-rail latch (detail)

To install the Unit with the DIN-rail brackets and latches, hold the unit in the vertical position with the bottom out and with the top toward the DIN-rail. Position the latches over the top of the DIN-rail, then snap the latches into holding position by moving the bottom of the switch inwards to a vertical position. The heavy-duty DIN-rail latches and brackets will hold the Unit securely in position, even with cabling attached to the unit.

To release the Unit from the DIN-rail, simultaneously press down the top of the DIN-rail latches to release the switch, which can then be dismounted by pulling the bottom out. Once the bottom of the Unit is rotated out, the DIN-rail latch is not engaged and the switch can be moved up and out, free of the DIN-rail mounting.

The following figure shows the vertical mounting of the Unit on a DIN-rail track for proper convection cooling. Note there is air space in the rear, as the Unit is held out from the rear of the panel by the mounting brackets. The Unit design uses the case for cooling (patent pending) and needs to be mounted vertically with air flow space in the front, rear, and sides.

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FIGURE 5: Unit mounted vertically with DIN-rail brackets and latches

The DIN-Rail mounting brackets and latches are optional and need to be ordered as separate items.

2.3.1 Mounting Dimensions with Metal Brackets

Each MultiLink Unit is supplied with metal mounting brackets and screws to mount the unit securely. It is recommended to mount the Unit vertically for proper cooling and long-life reliability. It is also advisable to mount the unit with space for air movement around the top and the sides, typically a minimum of 1 inch.

The back of the Unit unit is held out from the panel or wall behind it, creating a rear space of about ¼ inch or 1 cm. This allows air circulation and cooling of the rear part of the case. Since the Unit uses special internal thermal techniques (patent pending) to move the heat generated by the electronic components inside into the case, the case may be quite warm to the touch during normal operation.

The unit can be mounted using the brackets turned outside (normal) or inside (if space is tight). Attach the mounting bracket either outside or inside as shown in the illustration below (dotted line shown for the brackets inside). The spacing for the mounting screws into the supporting wall or panel is a rectangle 11.89" × 7.85" center-to-center.

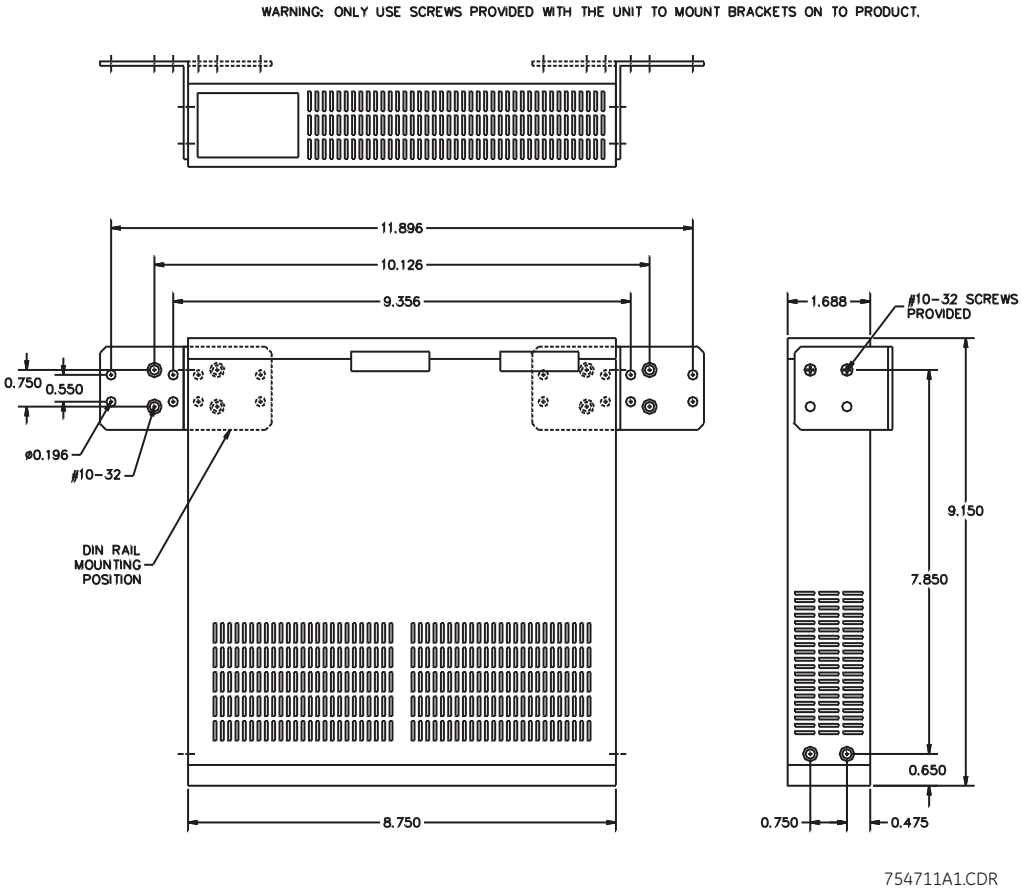


FIGURE 6: Unit mounting dimensions

2.4 DIN-Rail / Panel Mounting - ML1200/ML800

The Multilink ML1200/ML800 is designed for use in a "factory floor" industrial environment. It is available with optional DIN-Rail brackets to mount it securely in a metal factory floor enclosure, maintained vertically for proper convection cooling of the unit. The Unit requires one DIN-Rail mounting clip or latch for secure mounting.

The Din Rail Latching clips are mounted on the upper side corners of the ML1200/ML800 unit. Two threaded holes are provided on the sides of the Unit for DIN-Rail mounting purposes. See side view at the left. The required two screws are included with the DIN-Rail brackets, and are no.10-32 X 3/8 PHIL. PAN w/star washer. The two heavy-duty Din-Rail latches are designed as if that they can be manually accessed from the top when the Unit is installed on a DIN Rail.

To install the Unit with the DIN-Rail brackets and latches attached to it, hold it in the side vertical position with the bottom out, and with the top moved in toward the DIN-Rail. Position the latches over the top of the DIN-Rail. Then, snap the latches into holding position by moving the bottom of the Unit inwards to a vertical position. The DIN-Rail latches and brackets are heavy duty, and will hold the Unit securely in position, even with cabling attached to it.

To release the Unit from the DIN-Rail mounting, press the top of the two DIN-Rail latches down simultaneously to release the Unit so that it can be dismounted by pulling the bottom out. Once the bottom of the Unit is rotated out, the DIN-Rail latch is not engaged and it can be moved up and out, free of the DIN-Rail mounting.

If the Unit is to be mounted on a DIN-Rail track, for proper convection cooling of the unit there must be air space in the rear, as the Unit is held out from the rear of the panel by the mounting brackets. . Note that there is air space in the rear, as the Unit is held out from the rear of the panel by the mounting brackets. The ML1200/ML800 design uses the case for cooling (patent pending), and needs to be mounted vertically with air flow space around it in the front, rear, and sides.

The DIN-Rail mounting brackets and latches are optional and need to be ordered as separate items.

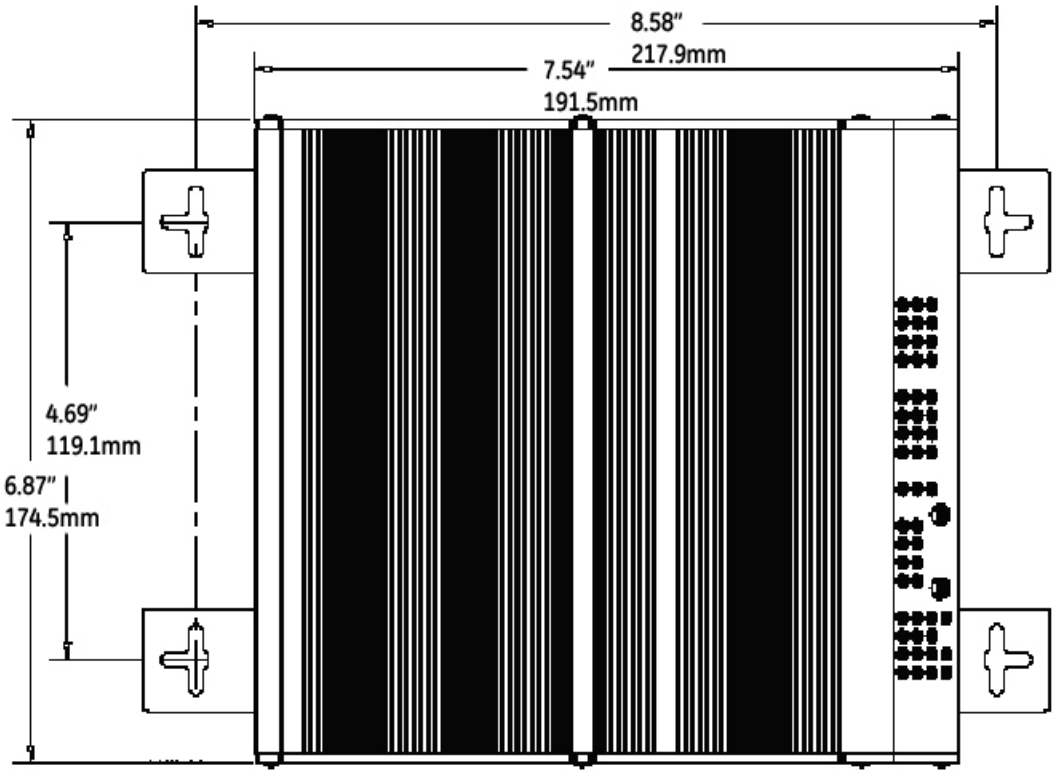
2.4.1 Mounting Dimensions for ML1200/ML800 with metal brackets

Each Unit is supplied with metal mounting brackets and screws to mount the unit securely on a panel or wall. It is recommended to mount the ML1200/ML800 Unit vertically, for proper cooling and long-life reliability. It is also advisable to mount the unit with space for air movement around the top and the sides, typically a minimum of 1 inch.

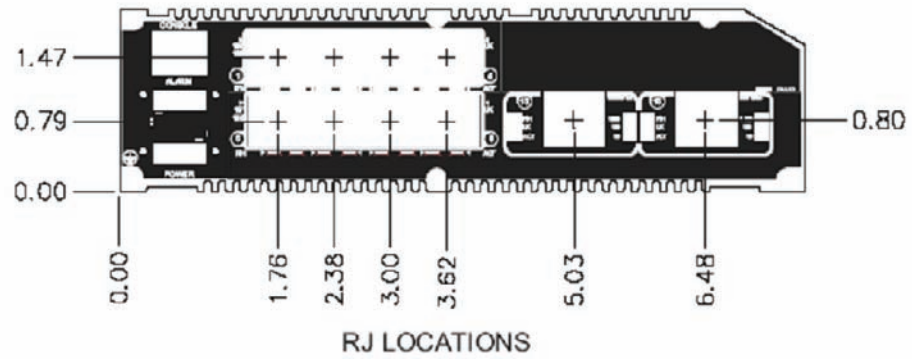
Note that the metal brackets supplied hold the back of the Unit out from the panel or wall behind it, creating a rear space of about ¼ inch or 1cm. This allows air circulation and cooling of the rear part of the case.

For best cooling of the Unit, attach the metal brackets to metal (rather than wood or plastic). Attaching to metal helps conduct heat away from the Unit through the metal brackets and into the metal support structure.

Since the Unit has special internal thermal techniques (patent pending) to move the heat generated by the electronic components inside into the case, the case may be quite warm to the touch during normal operation.



The Unit is mounted using the brackets as shown in the illustration above. The spacing for the mounting screws into the supporting wall or panel is a rectangle 21.74 x 11.91 cm (8.56 x 4.69 inches) center-to-center.



3 Electrical Installation

3.1 Powering the Unit - ML2400

Units with the AC power supply option can be connected directly to 110/240 V AC with the supplied power cord.

The standard high voltage (120/125 V AC/DC) or low-voltage (48 V DC) terminal block on the Unit is located on the rear of the unit and is equipped with three (3) screw-down lead posts. The power terminals are identified as positive (+), negative (–), and filter ground (⏚) for DC power and as live L(+), neutral N(–), and ⏚ for AC power. These terminals are floating inside the unit so that either may be grounded by the user if desired. The chassis or safety ground is the stud located beside the terminal block.

The connection procedure is straightforward. Simply insert DC leads to the Unit power terminal positive (+), negative (–), and ⏚ or AC leads to the live L(+), neutral N(–), and ⏚. Please ensure the correct polarity. The ⏚ should be connected to the safety ground, except during dielectric testing. Ensure that each lead is securely tightened.

FIGURE 7: Power connection and alarm contacts

NOTE

Always use a voltmeter to measure the voltage of the incoming power supply and properly determine the positive and negative leads.

NOTE

The GND should be hooked up first. The Unit has a floating ground, so the user may elect to ground either the positive or negative terminal.

When power is applied, the green PWR LED will illuminate.

The Unit is available with a redundant power supply option. If the redundant power supply is ordered, it should be wired as described above. The possible combinations of redundant power supplies are: HI-HI, HI-LO, LO-HI, and LO-LO. The AC power supply cannot be supplied with a redundant supply.

3.2 Powering the Unit - ML1600

Units with the AC power supply option can be connected directly to 110/240 V AC with the supplied power cord.

The terminal block for the HI and LO option on the Unit is located on the left front of the unit and is equipped with three (3) screw-down lead posts. The power terminals are identified as positive (+) and negative (–), and they are floating inside the unit so that either may be grounded by the user if desired. The chassis is "earth" or ground (⏚).

The connection procedure is straightforward. Simply insert the DC leads to the Unit power terminals, positive (+) and negative (-) screws. Please ensure correct polarity and that each lead is securely tightened.

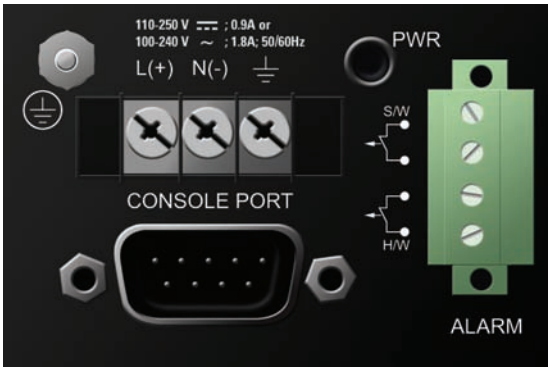


FIGURE 8: Power connection and alarm contacts

NOTE

Always use a voltmeter to measure the voltage of the incoming power supply and properly determine the positive or negative leads.

NOTE

The GND (⏚) should be hooked up first. The Unit has a floating ground, so the user may elect to ground either the positive or negative terminal.

When power is applied, the green PWR LED will illuminate.

3.3 Powering the Unit - ML1200/ML800

The DC internal power supply supports installation environments where the DC voltage is from 18 to 150 volts depending on the model selected. The power consumption will range from about 20 up to 35 watts, depending on the port quantity and types in the configuration.. When connecting the Ethernet cabling, there is no need to power down the unit. Individual cable segments can be connected or disconnected without concern for power-related problems or damage to the unit.

Power input options are available to suit the ML1200/ML800 Switches to special high-availability communications and/or heavy industrial-grade applications, including:

- -48VDC, 24VDC and 125VDC with single DC input,
- -48VDC, 24VDC and 125VDC with dual-source DC input

External AC power supplies are optional, see *Section 1.2* of the Reference Manual for Ordering Information.

See the Appendices of the reference manual for more details. Use an RFQ for other variations.

3.4 UL Requirements for DC-Powered Units

1. Minimum 18 AWG cable for connection to a centralized DC power source.
2. Minimum 14 AWG cable for connection to a earthing wiring.
3. Use only with listed 10 A circuit breaker provided in building installation.
4. "Complies with FDA radiation performance standards, 21 CFR sub-chapter J" or equivalent.
5. Fastening torque of the lugs on the terminal block: 9 inch-pound maximum.
6. For AC and HI powered units, use only with listed 20A circuit breaker provided in building installation. Circuit breaker shall be provided in end system or building as disconnect device.
7. Centralized DC power source cable securing; use at least four cable ties to secure the cable to the rack at least 4 inches apart, with the first one located within 6 inches of the terminal block.

3.5 Alarm Contacts

The alarm contacts feature provides two form-A normally closed (NC) contacts to which the user can attach two sets of status monitoring wires at the green terminal block. When this option is present, the terminal block for alarm contacts is part of the power input panel in the Unit case. The DC power input connection is in the same panel. A manual on-off switch for power to the unit is not available on Unit units with the alarm contacts option, as these two features occupy the same space in the case.

The first NC alarm contact (top position) is a "software alarm", operated by user settings in the Unit software. The user can disable the software alarm feature with a software configuration command if desired. When the software alarm is enabled, the form-A normally closed (NC) contact is held close during normal software operation. A user-defined software malfunction, such as an SNMP trap or a software security violation, causes the contact to open and thus trigger an alarm in the user's monitoring system

The second (bottom position) NC alarm contact is held closed when there is power on the main board inside of the Unit. This provides a "hardware alarm" because the NC contacts will open when internal power is lost, either from an external power down condition or by the failure of the Unit power supply. For an Unit with the redundant power supply option, the hardware alarm contact will change state if any one of the power supplies fails.

Useful information about the alarm contacts:

- The four terminal block (1, 2, 3, and 4) is adjacent to the power supply.
- The top two pins (1 and 2) are software operated.
- The bottom two pins (3 and 4) are hardware operated.
- By default, the alarm contacts are NC (normally closed).
- Software operation must be enabled to get the alarm traps. Further information is provided in this manual.

The green alarm contacts are on the front rear area (next to the power source) of the Unit.

3.6 Dielectric Strength (hi-pot) Testing

CAUTION

The shorting link between the ⏚ and safety ground must be removed prior to the dielectric strength test to protect the transient suppression circuitry of the power supply. For specific product details please refer to the appropriate product Reference Manual.

The figure below is a typical example of the set-up.

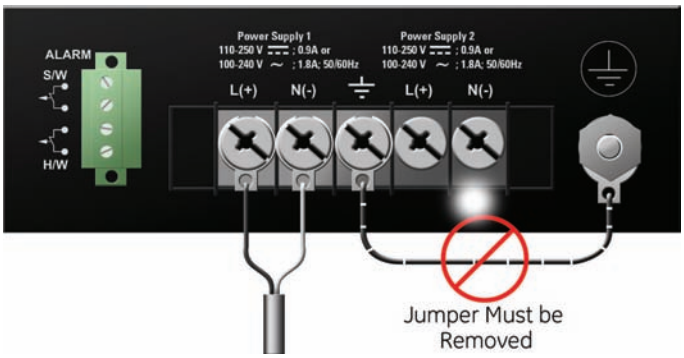


FIGURE 9: Dielectric strength testing

4 Connecting a Management Console Terminal to the Unit

4.1 Description

Use a **DB-9 to DB-9** null-modem cable (ML2400/ML1600) or **RJ45 to DB-9** null-modem cable (ML1200/ML800) to connect the Unit console port to the a PC.

NOTE

Console cables may be purchased as a separate items. They are not included with the Unit.

4.1.1 ML2400/ML1600

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FIGURE 10: Unit console port

The pin assignment for the console port are indicated in the following table.

Table 1: Console port pin assignment

Pin	Signal	Description
1	CD	Carrier detect (not used)
2	RXD	Receive data (input)
3	TXD	Transmit data (output)
4	open	not used
5	GND	Signal ground
6 to 9	open	not used

This information enables a management station (PC or console terminal) to connect directly to the switch console using a straight-through serial cable.

4.1.2 ML1200/ML800

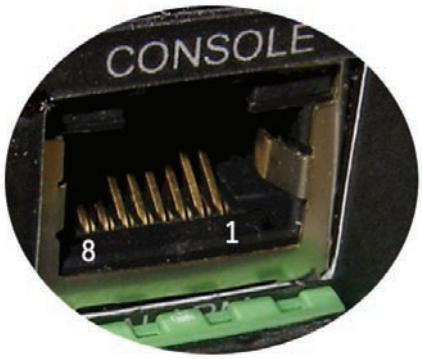


Table 2: Pinout information for above connector

Pin	Name	Description	Direction
1	RTX	Request to Send	OUT
3	TXD	Transceiver Data	OUT
4	GND	Ground	
5	GND	Ground	
6	RXD	Receive Data	IN
8	CTS	Clear to Send	IN

5 Introduction to Twisted Pair and Fiber Optic Ethernet LANs

This section will provide a brief review of modern Ethernet media before covering the steps to correctly configure the Multilink switch for typical protective relaying applications. For this discussion the range of IP addresses that will be used are within the range of 3.94.247.1 to 3.94.247.254 using a subnet mask of 255.255.255.0. This same range of addresses can be used for testing purposes but you should contact your IT support group for a valid range of addresses to be used for your particular application.

5.1 Ethernet Physical Layer: Twisted Pair Copper vs Fiber Optic

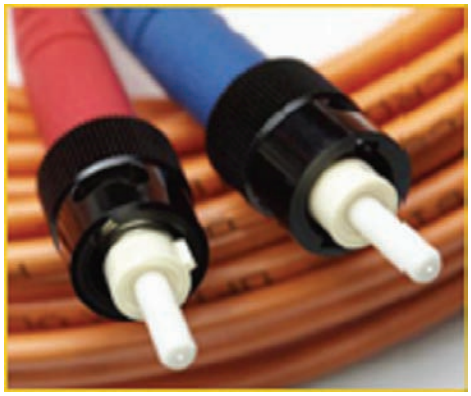
Today, the two most popular physical layer standards for Ethernet are twisted pair copper cable and fiber optic cable. Twisted pair copper is easier to terminate, has lower installation costs but is susceptible to electrical noise and a single run of twisted pair cable is distance limited.

Fiber optic media typically is able to be applied over much longer distances, is immune to electrical noise and while being more difficult to terminate the availability of per-fabricated cables has reduced the complexity of the installation within the substation dramatically.

5.1.1 Twisted Pair copper cable

- Easy to Terminate
- Low installation costs
- Susceptible to noise interference
- Limited by 100m distance
- Either shielded or unshielded (UTP)

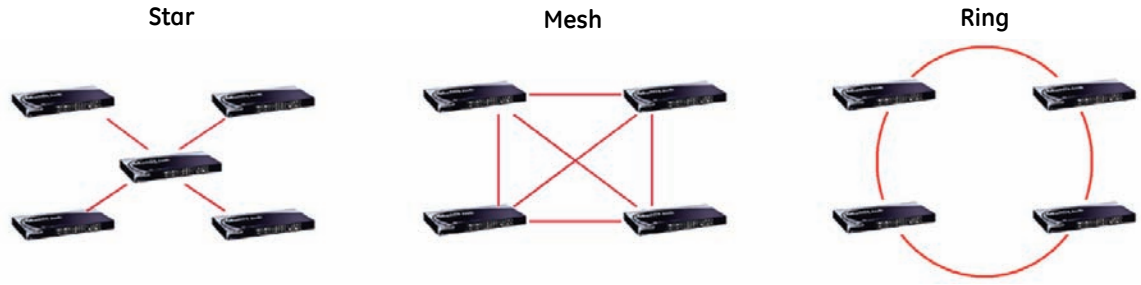
5.1.2 Fiber



- Longer distances possible, limited only by attenuation
- Immune to electrical noise
- More difficult termination and splicing
- Slightly higher cost for cable
- Two categories:
    - multi-mode
    - single-mode

5.2 Supported Network Topologies

With either media supported topologies include: star, mesh and ring. The port that connects one switch to another is often called the uplink port and with many switches the uplink port can operate at much higher baud rates than the standard ports. The link formed by the connection of of several switches higher speed uplink ports is often referred to as a backbone.



5.2.1 Star Architecture

- Single Point of failure before loss of communications
- Additional Ethernet switches Required
- Network Recovery in approximately 6 ms per Ethernet switch

5.2.2 Mesh Architecture

- Multiple Points of failure required before loss of communications

- Additional Fiber Cables required

5.2.3 Ring Architecture

- Full Network Redundancy
- Allows for Fastest Network Recovery (RO mode has typical recovery time of ≤ 5 ms/hop)
- Most Cost Effective Solution

5.3 10BASE T and 100BaseT Media

10 Base T and 100 Base T are the two most common twisted pair copper media standards. There are also several popular fiber optic media standards which we will review later in this section. With respect to 10 or 100 Base T, the 10 or 100 designation indicates a baud rate of either 10 or 100 megabits per second. Base stands for baseband while the T stands for "twisted pair."

Since many twisted pair interfaces can work at either baud rate, the designation 10/100 Base T has evolved to show this capability. The cable can be ether unshielded twisted pair (UTP) or shielded twisted pair (STP).

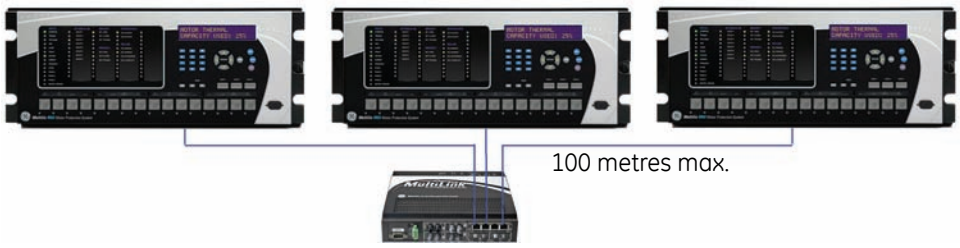
We recommend category 5e UTP for applications of up to 100 Mbs

5.3.1 Unshielded Twisted Pair cable:

- Category 1: Used for telephone communications; not suitable for transmitting data.
- Category 2: Capable of transmitting data at speeds of up to 4 Mbps.
- Category 3: Can be used in 10BASE-T networks; can transmit data at speeds up to 10 Mbps.
- Category 4: Used in Token Ring networks; can transmit data at speeds up to 16 Mbps.
- Category 5: Capable of transmitting data at speeds up to 100 Mbps.
- Category 5e*: Used in networks running at speeds up to 1000 Mbps (1 Gbps).
- Category 6: Consists of four pairs of 24-gauge copper wires, which can transmit data at speeds of up to 1000 Mbps.

* Recommended

5.3.2 Ethernet: Unshielded Twisted Pair



RJ45 Pin # (END 1)	Wire Color	Diagram End #1	RJ45 Pin # (END 2)	Wire Color	Diagram End #2
1	White/Orange		1	White/Orange	
2	Orange		2	Orange	
3	White/Green		3	White/Green	
4	Blue		4	Blue	
5	White/Blue		5	White/Blue	
6	Green		6	Green	
7	White/Brown		7	White/Brown	
8	Brown		8	Brown	

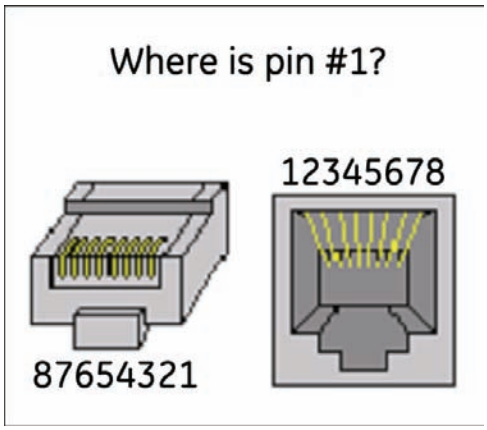


FIGURE 11: Pin Layout for a RJ45 Ethernet Straight-through Cable

The cable itself consists of four pairs of wires terminated in RJ45 connectors. The maximum permitted cable length is 100 meters. The cable pin connections can be one of two configurations. The first is called a "straight-through" cable and the second is called either a "crossover" or a "patch" cable. Whether the cable is straight-through or crossover as per standard* each of the wires within the cable has the following color code:

For the first twisted wire pair or wire pair #1: one wire is White with Blue bands while the other wire is Blue.

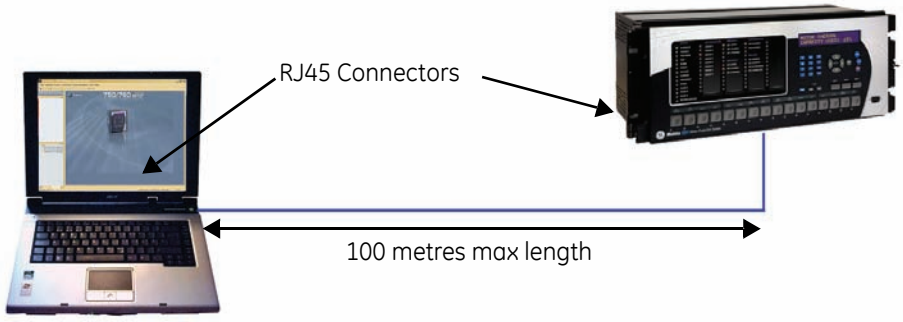
For the second twisted wire pair one wire is White with orange bands while the other wire is orange.

The third twisted wire pair #3 consists of a white wire with green bands and a second wire that is green.

The final wire pair, wire pair #4 consists of a white wire with brown bands while the other wire is Brown.

* The Electronic Industry Association (EIA) / Telecommunications Industry Association's (TIA) Standard 568B

The pin and wire configuration of a patch or crossover cable used to connect or establish a point-to-point Ethernet LAN between two Ethernet devices is shown here.



RJ45 Pin # (END 1)	Wire Color	Diagram End #1
1	White/Orange	
2	Orange	
3	White/Green	
4	Blue	
5	White/Blue	
6	Green	
7	White/Brown	
8	Brown	

RJ45 Pin # (END 2)	Wire Color	Diagram End #2
1	White/Green	
2	Green	
3	White/Orange	
4	Blue	
5	White/Blue	
6	Orange	
7	White/Brown	
8	Brown	

FIGURE 12: Pin Layout for RJ45 Ethernet Crossover (Patch) Cable

6 Connecting Ethernet Media

6.1 Description

The Unit s are specifically designed to support standard Ethernet media types within a single unit. This is accomplished by using a family of modules that are individually selected and configured.

The supported media types with the corresponding IEEE 802.3, 802.3D, 802.3u, 802.3AB and 802.3z standards and connector types are as follows:

Table 3: Ethernet media

IEEE standard	Media type	Distance
100Base-FX	multi-mode fiber	220 m
	single-mode fiber	5 km
10Base-T	twisted-pair	100 m
100Base-TX	100Base-FX	100 m

6.2 Connecting ST-type Fiber Optics (twist-lock)

The following procedure applies to installations using modules with ST-type fiber connectors. These are type A1, A2, A5, A6, and AF modules.

- ▷ Before connecting the fiber optic cable, remove the protective dust caps from the tips of the connectors on the module.
  Save these dust caps for future use.
- ▷ Wipe clean the ends of the dual connectors with a soft cloth or lint-free lens tissue dampened in alcohol.
  Ensure the connectors are clean before proceeding.

NOTE

One strand of the duplex fiber optic cable is coded using color bands at regular intervals. The color-coded strand must be used on the associated ports at each end of the fiber optic segment.

- ▷ Connect the transmit (TX) port on the module (light colored post) to the receive (RX) port of the remote device.
  Begin with the color-coded strand of the cable for this first TX-to-RX connection.
- ▷ Connect the receive (RX) port on the module (dark colored post) to the transmit (TX) port of the remote device.
  Use the non-color coded fiber strand.

The LINK LED on the module will illuminate when a connection has been established at both ends (assuming power is ON). If LINK is not lit after cable connection, the cause may be improper cable polarity. Swap the fiber cables at the module connector to remedy this situation.

6.3 Connecting SC-type Fiber Optics (snap-in)

The following procedure applies to installations using modules with SC-type fiber connectors. These include the A3, A7, A8, G3, G4, G5, G7, G8, GC, GF, GH, and GJ modules.

When connecting fiber media to SC connectors, simply snap on the two square male connectors into the SC female jacks of the module until it clicks and secures.

6.4 Connecting Single-mode Fiber Optics

When using single-mode fiber cable, be sure to use single-mode fiber port connectors. Single-mode fiber cable has a smaller diameter than multi-mode fiber cable (9/125 microns for single-mode versus 50/125 or 62.5/125 microns for multi-mode, where *xx*/*xx* represent the core diameters and the core plus cladding, respectively). Single-mode fiber allows full bandwidth at longer distances and may be used to connect 10 Mb nodes up to 10 km.

The same connection procedures for multi-mode fiber apply to single-mode fiber connectors.

6.5 Connecting RJ45 Twisted Pair

The RJ45 ports of the Unit can be connected to the following two media types: 100Base-TX and 10Base-T. CAT Five cables should be used when making 100Base-TX connections. When the ports are used as 10Base-T ports, CAT.3 may be used. In either case, the maximum distance for unshielded twisted pair cabling is 100 m (328 ft.).

It is recommended that high quality CAT. 5 cables (which work with 10 Mb and 100 Mb) be used whenever possible to provide flexibility in a mixed-speed network, as dual-speed ports are auto-sensing for 10 and 100 Mb/s.

The following procedure describes how to connect a 10Base-T or 100Base-TX twisted pair segment to the RJ45 port. The procedure is the same for both unshielded and shielded twisted pair cables.

- ▷ Using standard twisted pair media, insert either end of the cable with an RJ45 plug into the RJ45 connector of the port.
  Even though the connector is shielded, either unshielded or shielded cables may be used.
- ▷ Connect the other end of the cable to the corresponding device.
- ▷ Use the LINK LED to ensure connectivity by noting that the LED will be illuminated when the unit is powered and connection is established.

The Unit RJ45 Gigabit ports can be connected to 1000Base-T, CAT.5E (or better), 100 Ω UTP, or shielded twisted-pair (STP) balanced cable media. The CAT.5E or shielded twisted pair (STP) balanced cable is recommended when making 1000Base-TX connections. In either case, the maximum distance for unshielded twisted pair cabling is 100 m (328 ft.).

It is recommended that high quality CAT. 5E cables (which work at both 100 and 1000 Mb) be used whenever possible to provide flexibility in a mixed-speed network.

The following procedure describes how to connect a 1000Base-T twisted pair segment to the RJ45 port. The procedure is the same for both unshielded and shielded twisted pair cables.

1000Base-T connections require that all four pairs or wires be connected:

- ▷ Insert either end of the cable with an RJ45 plug into the RJ45 connector on the module.
  Although the connector is shielded, either unshielded or shielded cables may be used.
- ▷ Connect the other end of the cable to the corresponding device.
- ▷ Use the LINK LED to ensure connectivity by noting that the LED will be illuminated when the unit is powered and connection is established.

6.6 Connecting Gigabit Media using GBICs

The Gigabit ports accept industry-standard GBICs for user selection of the gigabit media type desired. A selection of fiber and copper GBICs are available.

7 Hubs and Switches

Two of the major Ethernet LAN components are "hubs" and "switches." There are many advantages of a switch over a hub. Hubs just transfer information from one port to all other ports. Since a hub has no way of handling media contention, collisions can occur requiring all segments connected to a hub to work in a half duplex mode. Switches on the other hand have the capability of buffering messages allowing full duplex operation. A switch will also learn the MAC addresses of devices connected to each of it's ports and will then route messages to just the port to which the destination device is connected, thereby reducing data traffic on the network. Switches that have configuration firmware to customize the switch and traffic are called "managed switches". Switches that have fixed configurations are referred to as "unmanaged switches".

7.1 Fiber Optic Ethernet:

Fiber optic Ethernet is rapidly becoming the medium of choice in applications where longer distances and immunity to EMI are of importance, such as power system applications. However, the higher cost and the difficulty of terminating fiber cables allows twisted pair to continue to play a roll were appropriate.

The wavelengths of light used in fiber optic communication are 820, 1300 and 1550 nanometers (nm) because it has been found that these wavelengths of light are attenuated the least as they travel through the fiber optic medium. Compatible ports must operate at the same wavelength of light and be linked with appropriate fiber. There are two categories of fiber optic cable: "multi-mode" and "single-mode." Note that until recently, the cable used with 820nm wavelength light was offered only in multi-mode while 1300nm wavelength light uses both single and multi-mode compatible cable. Cable compatible with 1550nm wavelength light is offered only in single mode.

7.1.1 Wavelengths of light

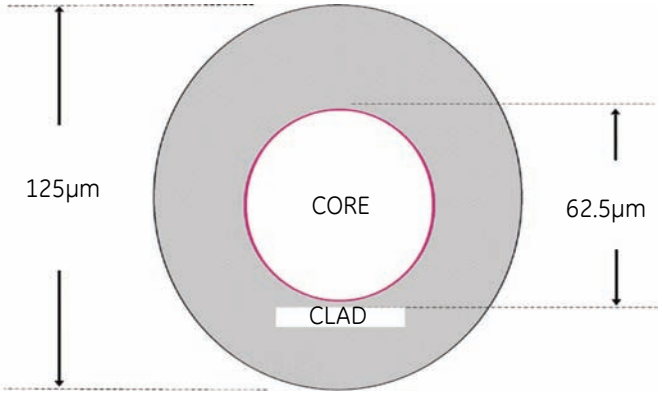
	Multi-Mode	Single-Mode
820nm	X	X
1300nm	X	X
1550nm	N/A	X

Note that both devices must use the same wavelength of light.

7.2 Single and Multi-mode cable

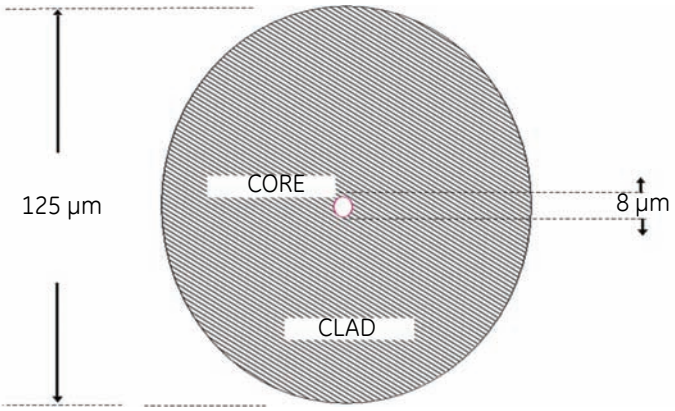
7.2.1 Fiber Cable Cross Section and Physical Specifications

Multi Mode



- 62.5/125 µm
- 50/125 µm*

Single Mode



- 9/125 µm

* Will become more popular as baud rate goes up

This is a scaled drawing of both a 62.5/ 125 µm multi mode fiber and 9/125 µm single mode fiber. The outer clad of both is 125 micrometers in diameter. The multi-mode core, at 62.5 micrometers, is a little bit thinner than the average human hair. The core of the 9/125

micrometer fiber is 8 microns in diameter (almost an eighth of that of the Multi-Mode fiber) surrounded by a second outer clad. This clad can pass a light signal, so for this reason the fiber is referred to as 9 by 125 micrometer fiber.

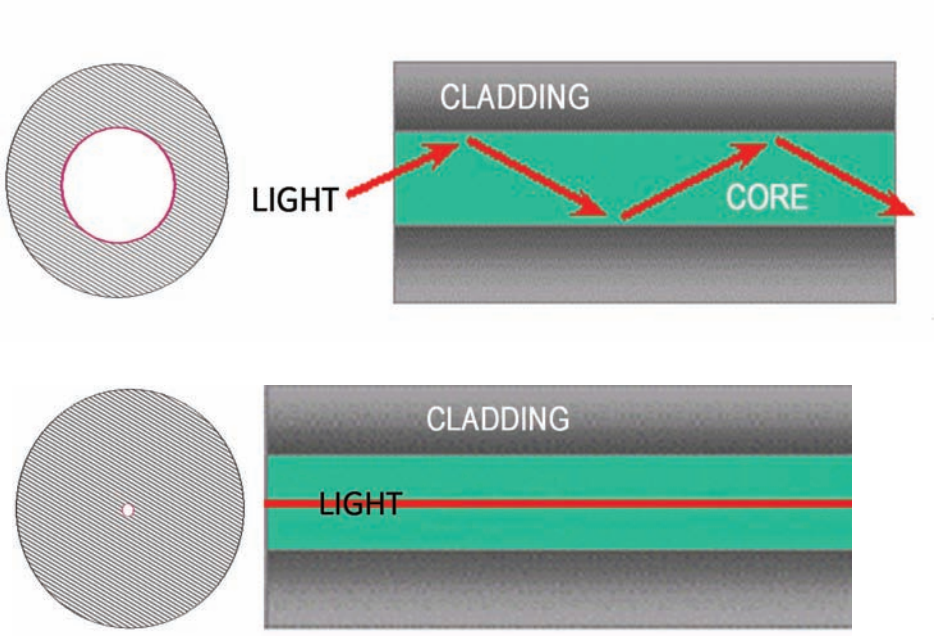


FIGURE 13: Differences between Multi-Mode and Single-Mode Cable

7.2.2 Single mode fiber - Less attenuation per unit distance

The difference between multi-mode and single mode cable can be best described as follows:

With multi-mode fiber the index of refraction at the surface between the core and the cladding is such that there is total internal reflection of the light being transmitted down the core. Picture this by imagining that the clad is a tube whose interior surface is polished so smooth, it is like a mirror. Light shinning at one end of the tube will either travel straight down the tube or will travel down the tube by reflecting of the inner mirrored surface.

Single mode fiber can be described as an elongated lens that is continuously focusing the light into the centre of the fiber. Using these two analogies it can be imagined that in the single mode fiber more light travels through far less fiber medium resulting in far less attenuation per unit distance than it does in multi-mode fiber. As a result, for a given wavelength of light, single mode fiber typically has less attenuation per unit distance than multi-mode fiber.

8 Optical Power Budget

Inevitably the question that arises is “What is the maximum practical communication distance when using a fiber optic cable?”. The answer isn’t straightforward, but must be calculated as follows:

- First the "Optical Power Budget" is determined by subtracting the receiver’s rated sensitivity from the transmitter’s rated power, both of which are defined in decibels of light intensity. For example if a particular transmitter is rated at minus15 db and the receiver’s sensitivity is rated at minus 31 db, the difference of 16 db is the "Optical Power Budget."

```
Xmt Output Pwr - Rcv Sens = OPB: Optical power budget
Magnum: ( -15.0 dB ) - (- 31.0dB)= -16 dB OPB
```

The Optical Power Budget can be thought of as the maximum permitted attenuation of the light signal as it travels from the transmitter to the receiver, while still permitting reliable communication.

- The next step is to calculate the worst case Optical Power Budget by subtracting from the Optical Power Budget, 1 dB for LED aging and 1 dB for each pair of connectors (referred to as "insertion loss").

```
Worst Case OPB = OPB - 1dB (for LED aging) – 1dB (insertion loss for
each pair of connectors) x number of pairs
```

The final step is to divide the calculated result by the rated cable loss per kilometer to determine the maximum distance.

For costly installations it is recommended that you always measure the actual cable loss before and immediately after the installation to verify that the cable was installed correctly. To avoid damaging the receiver, ensure that the maximum optical input power of the receiver isn’t exceeded.

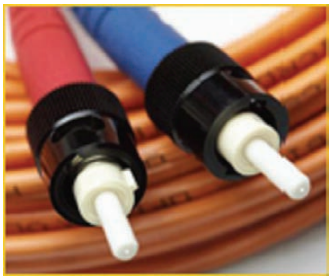
- Worst case distance = {Worst case OPB, in dB} / [Cable Loss, in dB/Km]

where the “typical cable loss” for:

- 62.5/125 and 50/125ìm (M.m) is 2.8 dB/km
- 100/140 (Multi-mode, 850nm) is 3.3 dB/km,
- 9/125 (Single-mode, 1310nm) is 0.5 dB/km (a worst case industry number)
- 9/125 (Single-mode, 1310nm) is 0.4 dB/km (LXSC25)
- 9/125 (Single-mode 1550nm) is 0.25 dB/km (ZXSC40, SSCX)
- 9/125 (Single-mode 1550nm) is 0.2 dB/km (ZXSC70) and
- 9/125 (Single-mode 1550nm) is 0.22 dB/km (ZXSC120)

These are typical cable losses. There will be deviations depending on the manufacturer. Always measure the loss before installation.

Several styles of connector are used to terminate the attached to the end of the fiber cable. The ST and SC connectors shown below, are among the more popular. Ensures that the UR CPU, switch, and cable have compatible connectors.



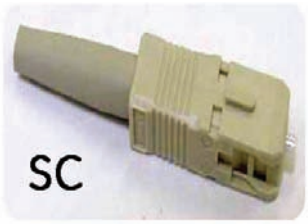


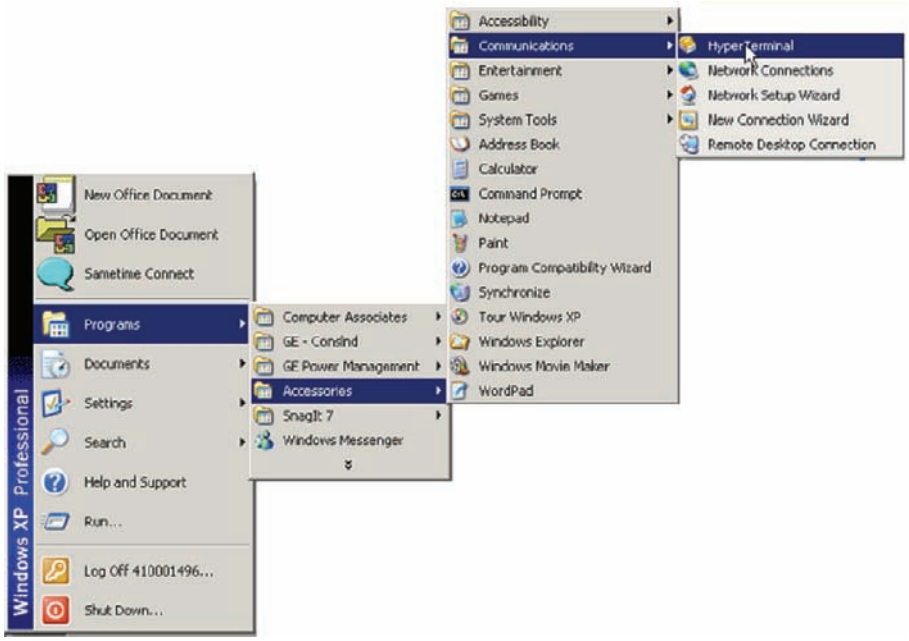
FIGURE 14: Common Fiber Optic Connectors

8.1 Assigning an IP address to the Multilin Switch

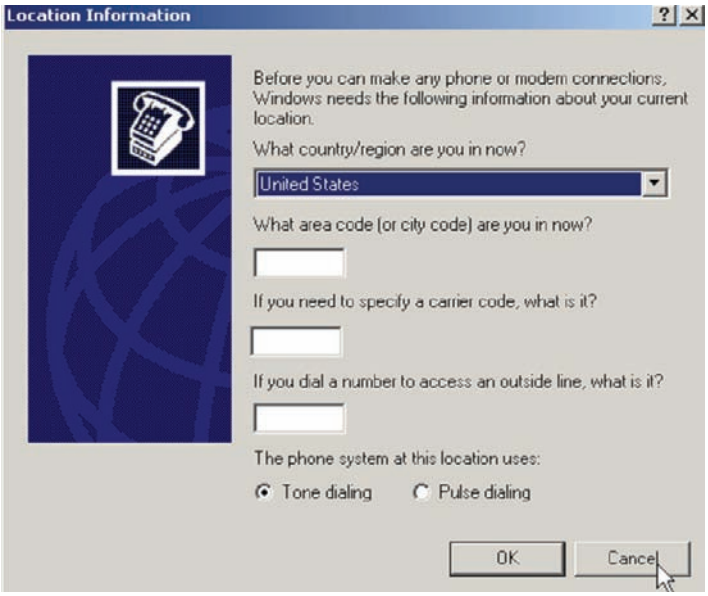
The easiest way to configure the switch is through the WEB interface. The switch has been shipped with a default IP address of 192.168.1.2 and a subnet mask of 255.255.255.0. Consult your network administrator to determine if the IP address, subnet mask or default gateway needs to be modified. In our example test network the valid rang of IP addresses is from 3.94.247.1 to 3.94.247.254.

The easiest way to assign an IP address and subnet mask is through the switches console serial port. A null-modem cable is required to connect the console port to the computer's serial port. (For ML2400/ML1600, a **DB-9 to DB-9** null-modem cable is required. For ML1200/ML800, a Cisco-compatible **RJ45 to DB-9** null-modem cable is required.)

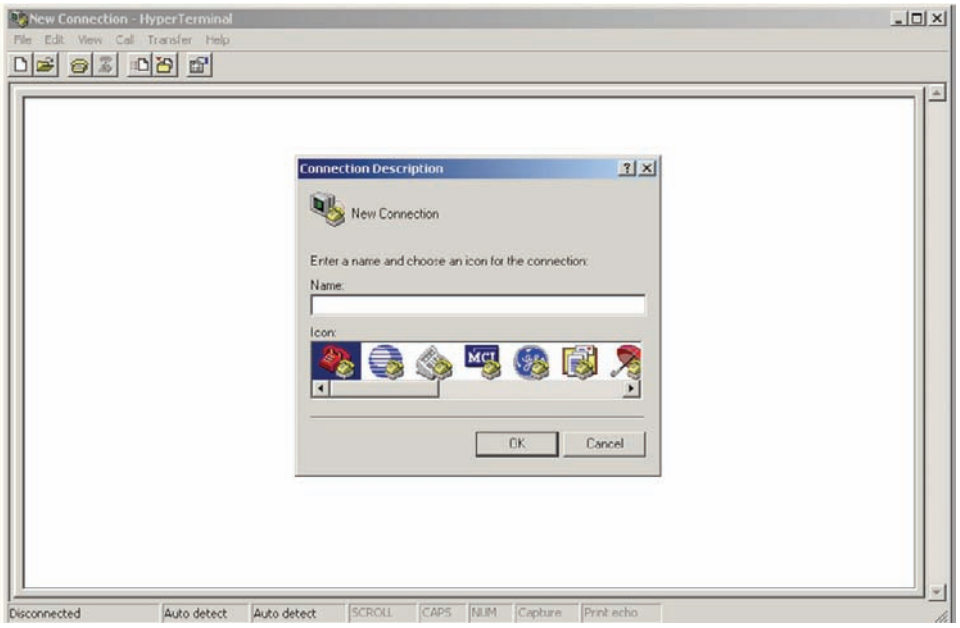
The Hyperterminal utility application is a convenient standard firmware tool that will be used to configure the switch. This program is found on most windows based operating systems under programs > accessories > communications > Hyperterminal.



▷ Once the HyperTerminal application is launched you will need to cancel HyperTerminal's dial sequence by left mouse clicking on the **Cancel** pushbutton. This will allow you to access Hyperterminal's configuration menus.



▷ Select an icon and name to use for saving the new Hyperterminal configuration.

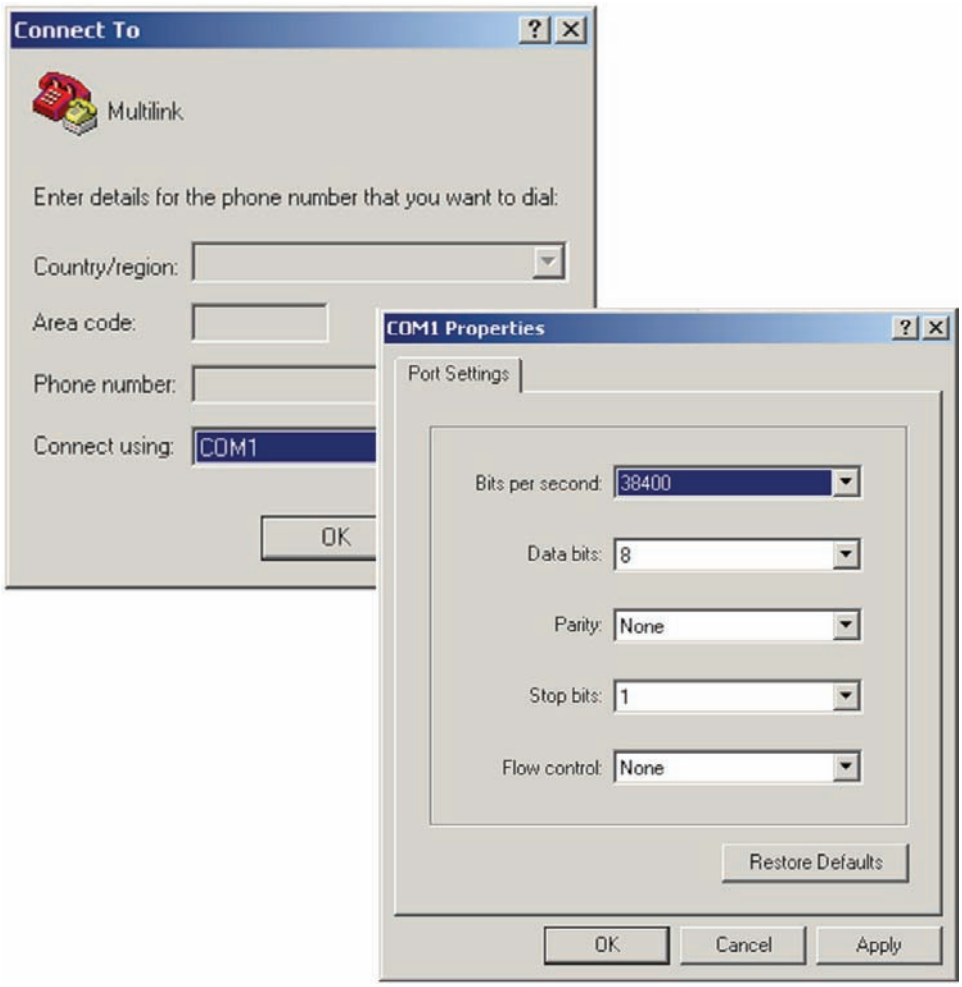


▷ Select the computer's serial port that is connected to the Multilink switch.

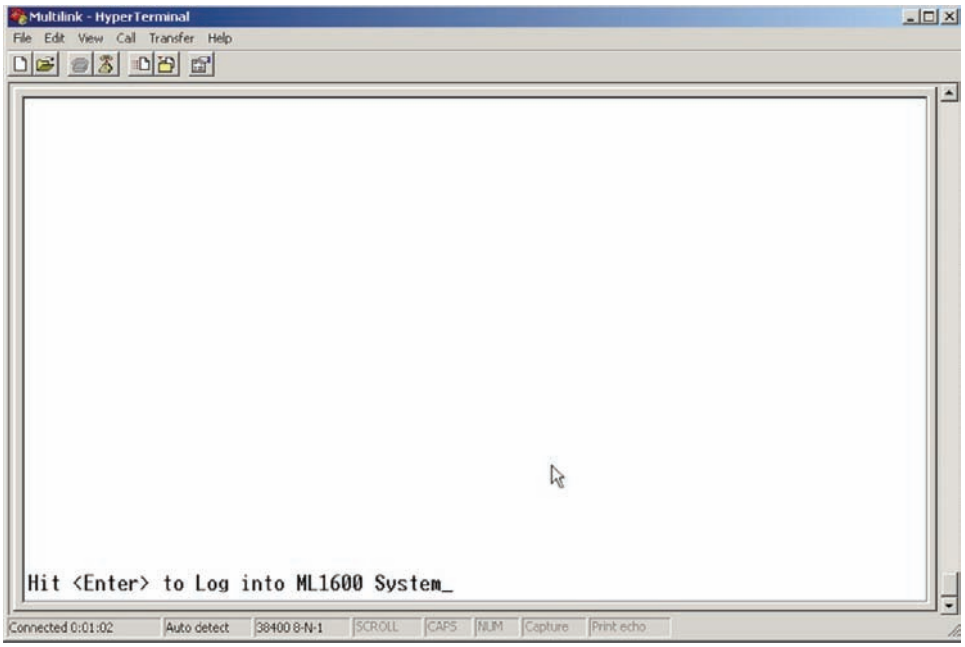
▷ Select **OK**.

▷ In the next window set the baud rate to **38400**, data bits to **8**, **no parity**, **one stop bit** and set the flow control to **none**.

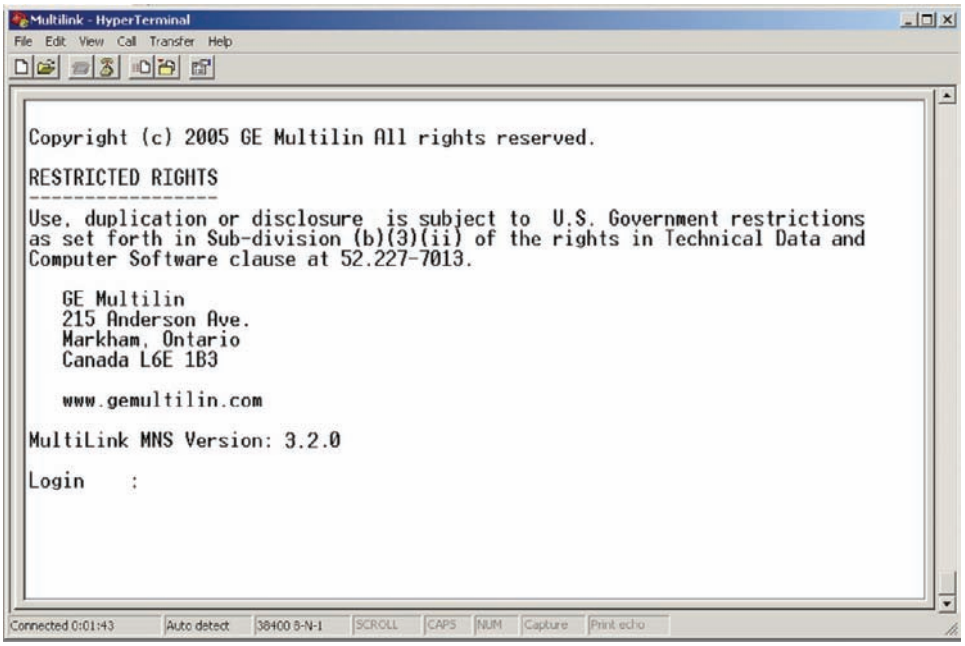
▷ Left mouse click on the **OK** icon to attempt communication to the Multilink switch.



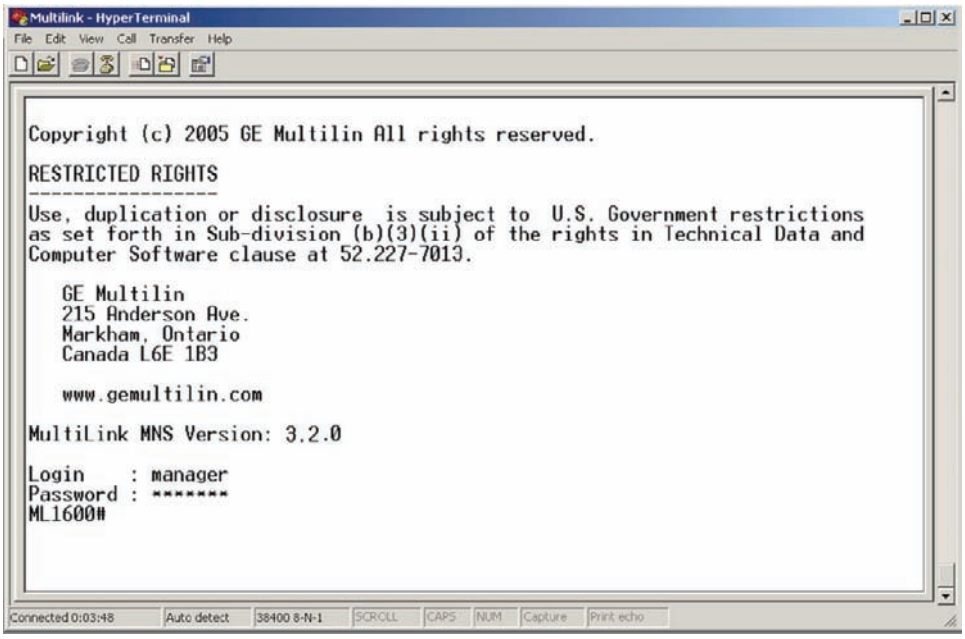
▷ Press the **Enter** key until the message **Hit <Enter> to log into Unit system** is displayed.



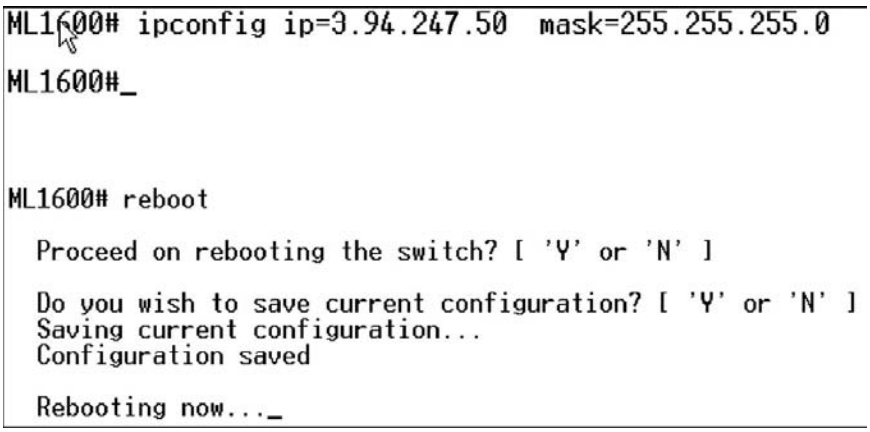
▷ Press the **Enter** key one more time to get the login prompt.



▷ Enter the login name **manager** and the default password **manager**. Once you are successfully logged in, the prompt will change to the model number of the switch you are connected to, followed by the pound (#) sign, indicating a successful login.



In this example the switch that the computer is connected to is a **Multilink ML1600**.



The instruction manual for the MultiLink provides a list of all instructions. A valid IP address and subnet mask can be programmed into the switch using the **IP config** command as follows:

- Type **ipconfig ip=**, then enter the IP address (in our example we will use a unique address between 3.94.244.1 and 3.94.244.254), followed by a space.
- Type **mask=**
- Enter the mask (in our example system we would use 255.255.252.0).
- If a default gateway is also required enter a space and type **dgw=**
- Enter the ip address of the gateway.

- ▷ Select the **Enter** key.
  The switch will ask if you would like to reboot the switch.
- ▷ Select **Y** for yes and **Y** again to save the new settings.
- ▷ Once the switch has completed a reboot, the new IP and subnet mask will be in effect.

```
Login    : manager
Password : *******
ML1600# show setup

  Version             :  ML1600 build 3.2.0   Feb 3 2009 11:11:37
  MAC Address         :  00:20:06:2b:33:30
  IP Address          :  3.94.248.1
  Subnet Mask         :  255.255.255.0
  Gateway Address     :  3.94.248.1
  CLI Mode            :  Manager
  System Name         :  ML1600
  System Description  :  16 Port Modular Ethernet Switch
  System Contact      :  multilin.tech@ge.com
  System Location     :  Markham, Ontario
  System ObjectId     :  1.3.6.1.4.1.13248.12.6

ML1600#
```

Once the switch has rebooted you will need to log in again. To confirm that the IP address and subnet mask were saved correctly enter the command **show setup** followed by the **Enter** key. The Multilink switch will then provide an on-screen list of the switch settings including the switch IP address and subnet mask and if programmed, the default gateway. Once you have verified that the IP, subnet mask and default gateway settings are correct you can configure the switch via the web interface.

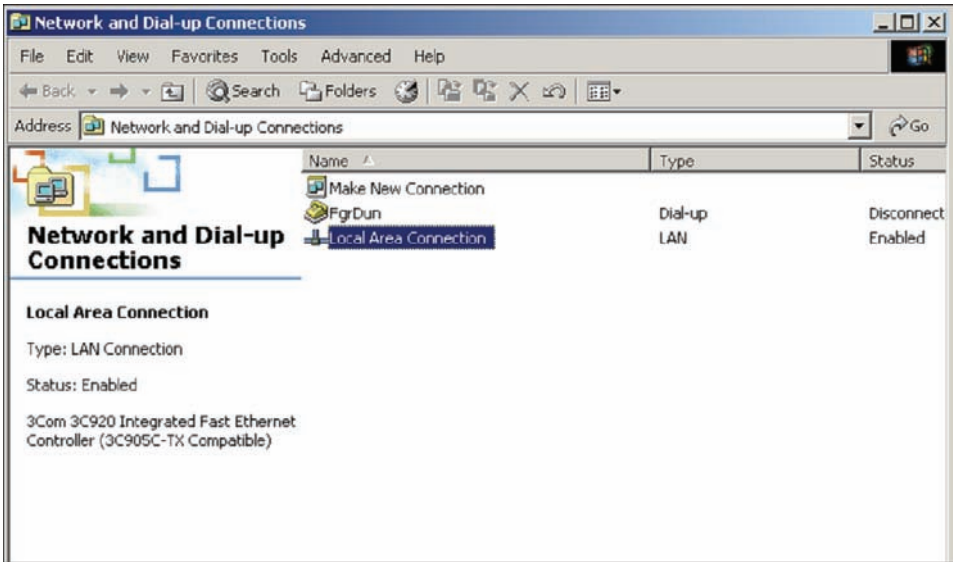
8.2 Assigning a static IP Address to a personnel computer

In order to configure the switch using the web-based interface the computer must be assigned an IP address and subnet mask. If you are already familiar with this procedure you may skip this step.

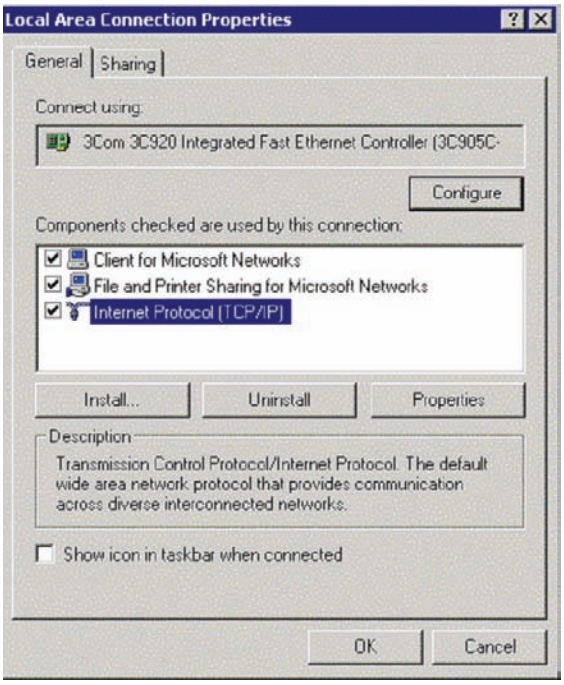
▷ Obtain an IP address, subnet mask, and possibly a gateway address, from the LAN administrator.

There are rules associated with the assignment of these numbers, which go well beyond this introduction. As mentioned at the beginning of this guide, for our test network we will be using a subnet mask of 255.255.255.0 for all computers and relays on the network. The IP address of each device on the network must be unique. Given that in this example the switch was assigned an IP address, 3.94.247.50, we are left with 253 unique addresses.

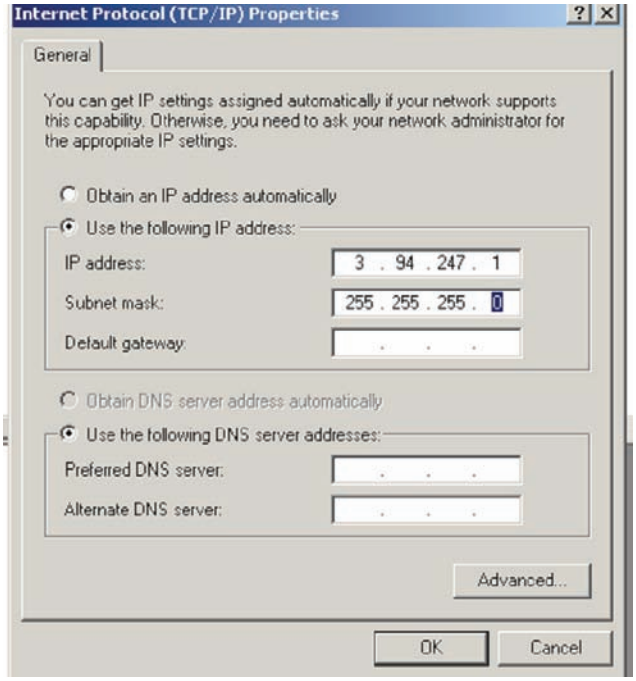
▷ Once the computer has booted up, right click on the icon labeled **My Network Places** followed by the **Properties** selection.



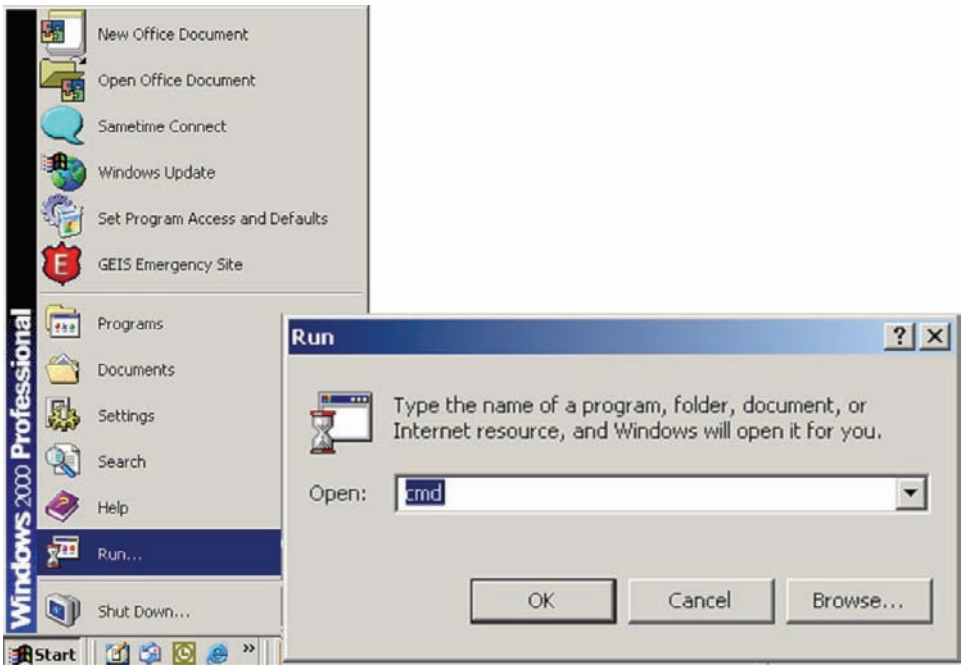
▷ Right mouse click on the **Local Area Connections** icon and select **Properties**.



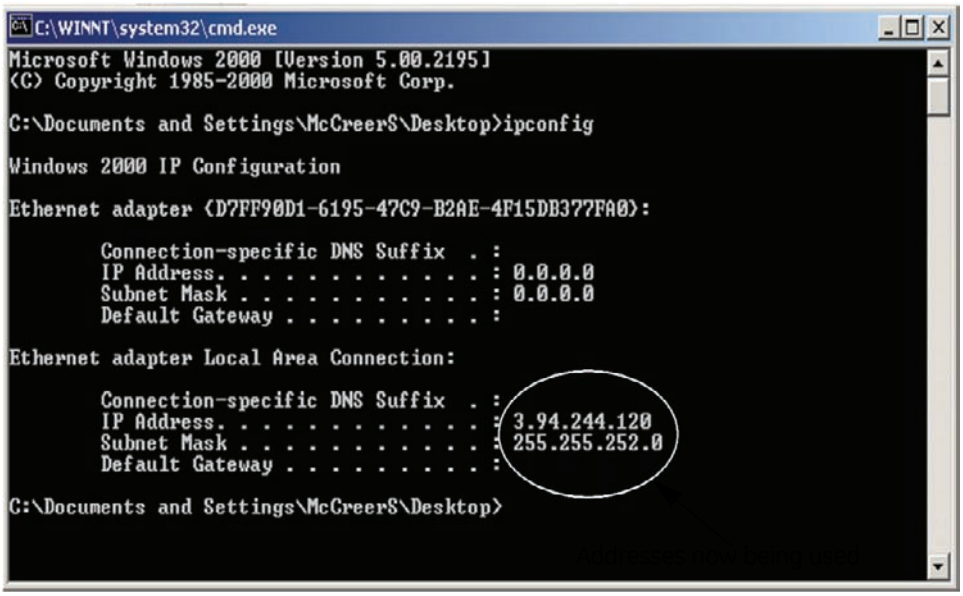
▷ Locate and click on the Ethernet card (it will have **TCPIP Protocol** as part of its name).
The Ethernet card is typically referred to as an **Ethernet adaptor**.



- Select **Use the following IP address** then enter a unique IP address (from 3.94.247.001 to 3.94.247.254 if using our test network address range).
- Enter the subnet mask which, if using our test network, will be 255.255.252.0.
- Select **OK**, then **OK** again to exit the LOCAL AREA NETWORK PROPERTIES menu.
- Connect the computer's Ethernet port to the switch using a straight-through cable.
- Ensure that the link LED come on, on both the switch and PC.



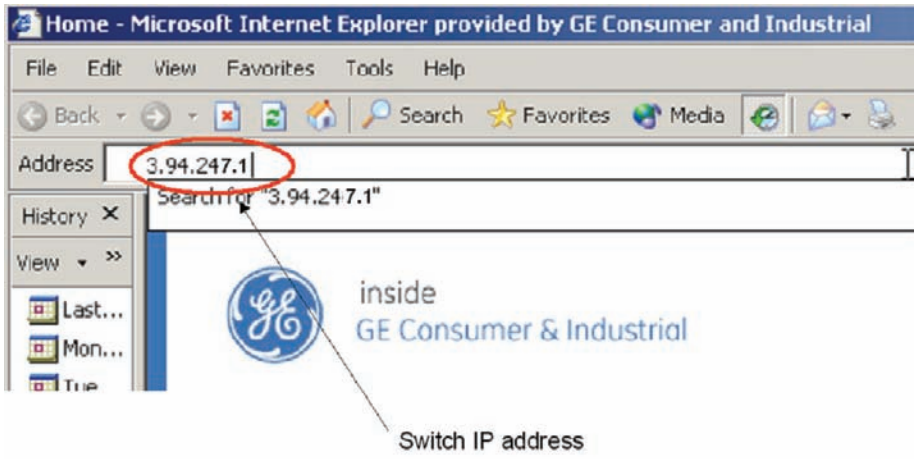
▷ Select **Run** then enter **CMD** to start the DOS shell.



Once the DOS shell has launched, you will be presented with a DOS window.

▷ At the DOS prompt enter the command **ipconfig** followed by the **Enter** key.

This is the command that will cause the Ethernet adaptor to immediately use the IP, and Subnet Mask addresses just programmed. An on-screen report will appear indicating which addresses are now being used by the adapter. The computer's configuration is complete.



▷ Next launch **Internet Explorer** and enter the IP address of the switch to go to the switch's web page.

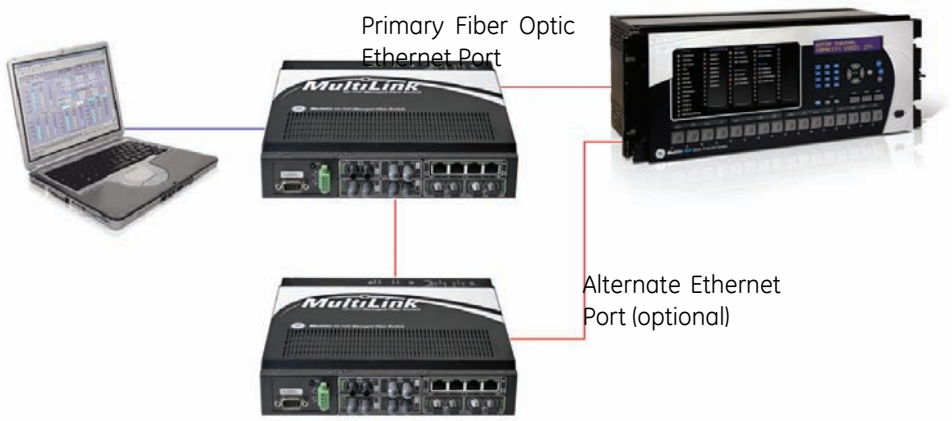
▷ At the Multilink login web page, enter the default Login name, which is **manager**.

▷ Enter the default login Password, which is again **manager**.

▷ Left mouse click on the **Login** pushbutton to attempt to log in.

If you have successfully logged in you will be presented with a graphic of the particular Multilink switch to which you are connected.

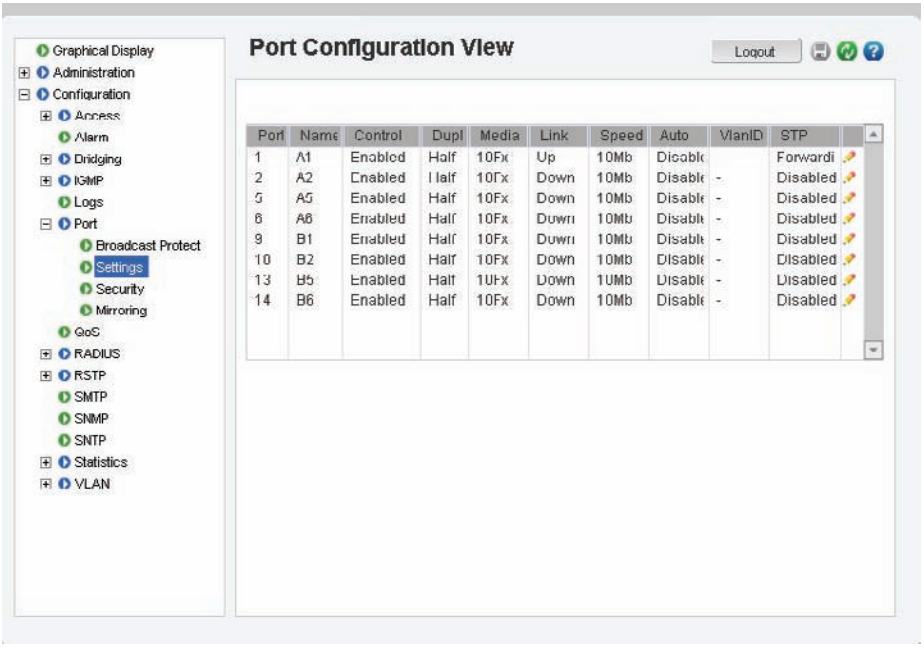
8.3 Configuring the switch ports for UR redundant operation



The universal relay offers a redundant port option once the link loss alert feature is enabled on the associated port, the relay will be able to detect a failure of the link, alarm, and switch to the alternate port. The following procedure should be used to enable Link Loss Alert on each of the the ports used in the redundant configuration.

- ▷ Note the names of all switch ports that will require the Link Loss Alert feature to be enabled.
  In our example the port named **A1** is one of the ports that will be used in a redundant configuration, so the Link Loss Alert feature must be enabled on this port.
- ▷ Double click on the **Switch Port** icon to open the main port configuration screen.

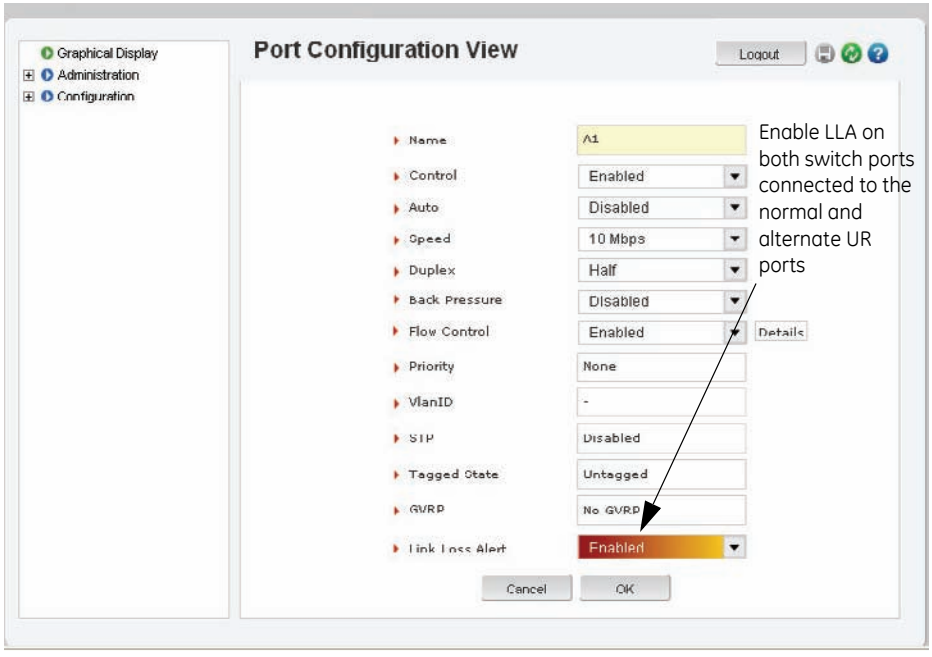
▷ Select the **Edit** icon for port number one which has the name **A1**.



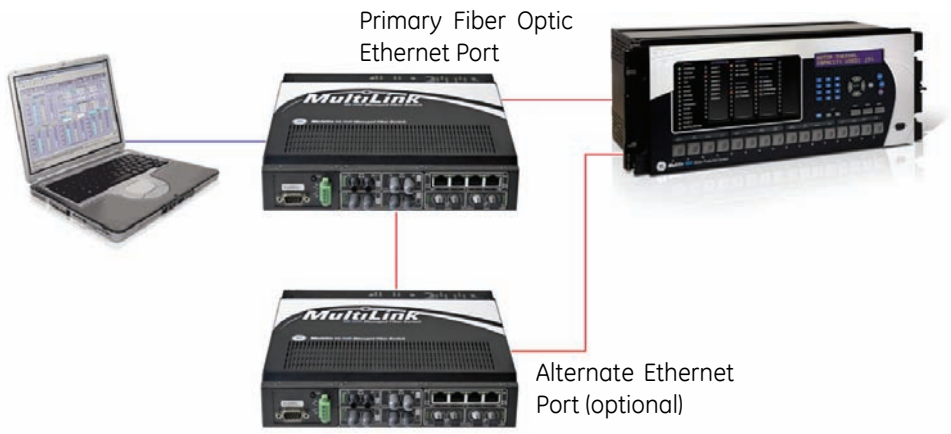
▷ Ensure that the LINK LOSS ALTER feature is enabled on port A1.

▷ To save the change (if made) click on the **Save** icon.

▷ Repeat this procedure for the fiber optic port on the second switch..



To test the operation of the redundancy proceed as follows:



- ▷ Establish communication to one of the relays.
- ▷ Disconnect the normal port's transmit or receive fiber.
- ▷ Note that communications to the relay aren't disrupted, and check that Ethernet port diagnostics are enabled.
  The message - primarily **Ethernet Fail** - will be seen on the display.

The relay has switched over to the alternate port.

9 Tagged VLANs & Ring Only Mode

VLAN is short for "Virtual LAN." A VLAN creates separate network segments that can span multiple Multilink switches. A VLAN is a group of ports designated by the switch as belonging to the same broadcast domain. VLANs provide the capability of having multiple networks co-existing on the same switch. Two advantages of VLANs are the separation of traffic and security.

VLANs can be port based or tag based. Port based VLANs assigns a specific port or group of ports to belong to a VLAN. When using tag based VLANs, a tag called a VLAN identifier is sent as part of the message. This tag allows the message to move across multiple switches whose ports are part of the same tagged VLAN.

Tagged VLANs and priority are used within IEC 61850 GOOSE messaging.

The objective of this exercise is to become familiar with the correct procedure to configure tagged VLANs within the GE Multilink switches, to support the IEC61850 GOOSE peer to peer messaging service.

9.0.1 Background:

The IEC 61850 Fixed GOOSE peer-to-peer communication service is an enhanced version of IEC GSSE peer-to-peer service with the additional ability of assigning a priority and what is called a "tag" to the multicast messages.

9.1 Configuring Tagged VLANs

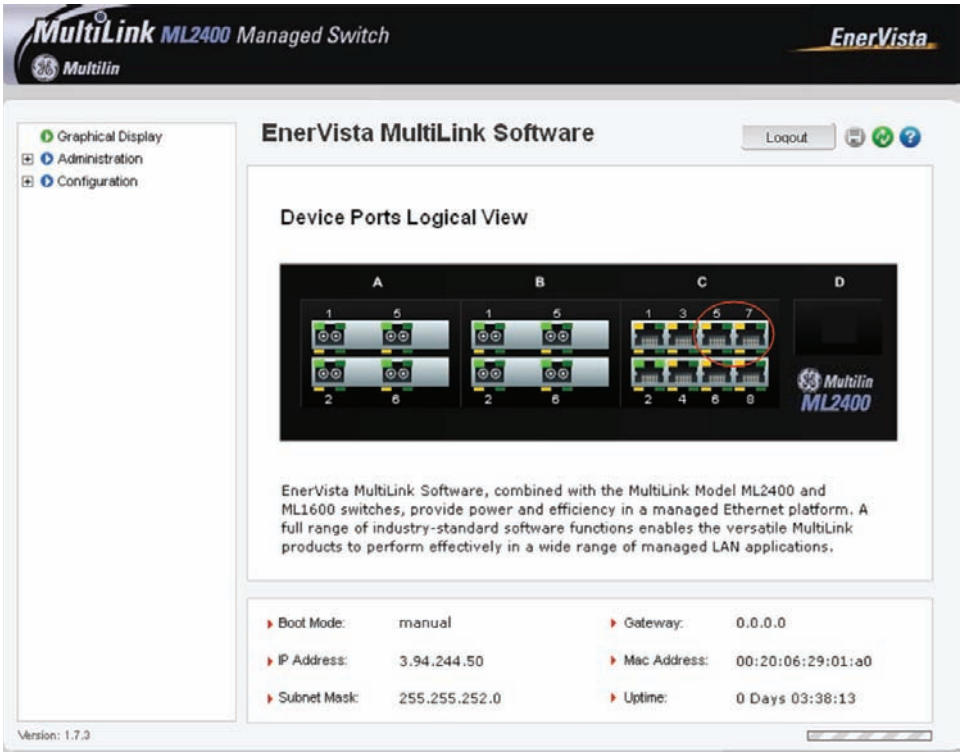
FIGURE 15: Tagged Virtual LANs

9.1.1 Configuring a VLAN within the switch

▷ First determine which physical ports are to be part of the tagged based VLAN.

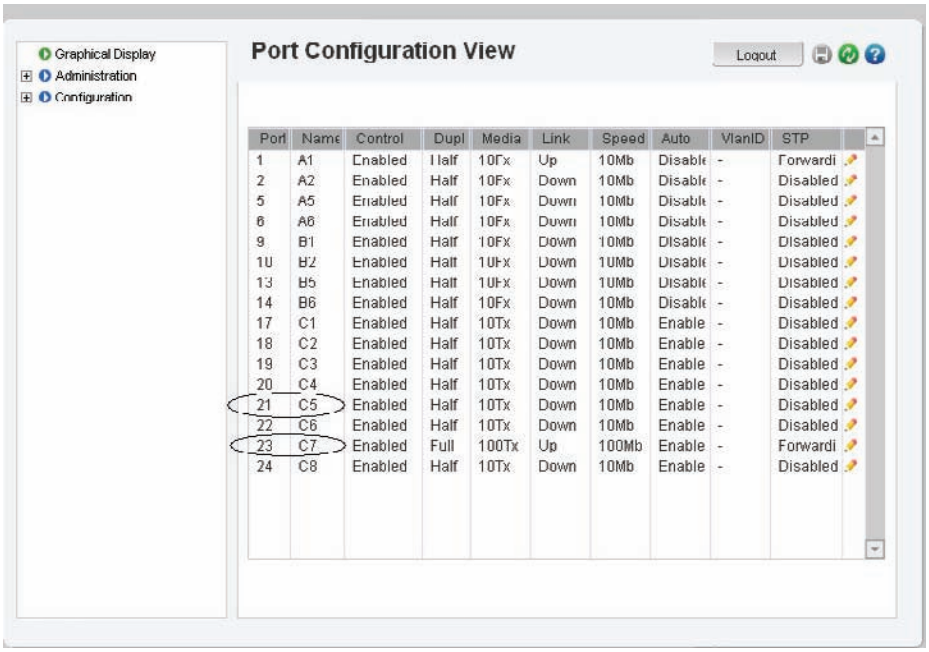
▷ Take note the names of the associated ports displayed on the Multilink home page.
In our example we want the ports named C5 and C7 to be part of the VLAN.

▷ Once the port names have been determined, open the main port configuration page by double clicking on one of the **Port** icons.



In this page we can see that the port named C5 has been assigned port number 21 and the port named C7 has been assigned port number 23. We want to assign ports 21 and 23 to their own single VLAN.

▷ Note these port numbers.

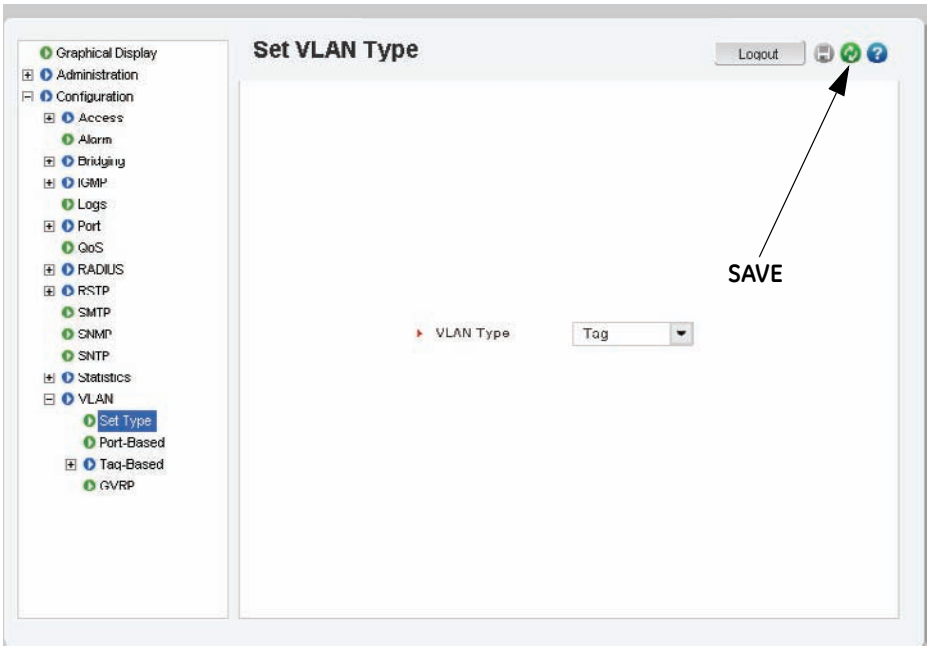


▷ Now open the VLANs menu and select the **Type** menu.

▷ In this menu set the VLAN type to **tag**.

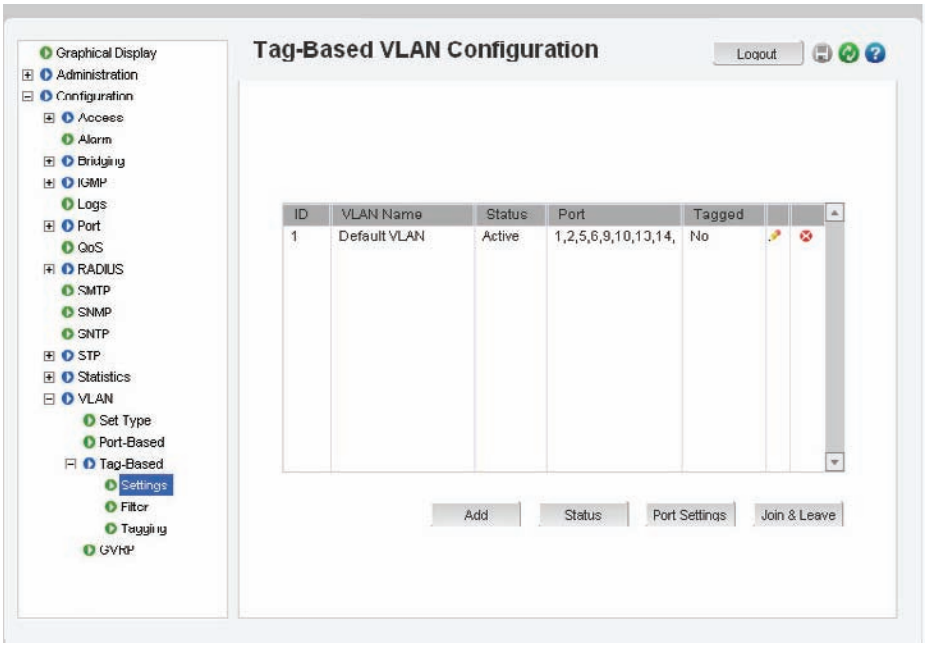
▷ Select the **Save** icon.

We have now configured the switch to support tagged based VLANs.



We can now proceed to the tagged based VLAN menu . From this menu we can see that all ports have been assigned to the default tag based VLAN 1.

▷ To create a new tag based VLAN to which to assign ports 21 and 23, first click on the **Add** pushbutton.



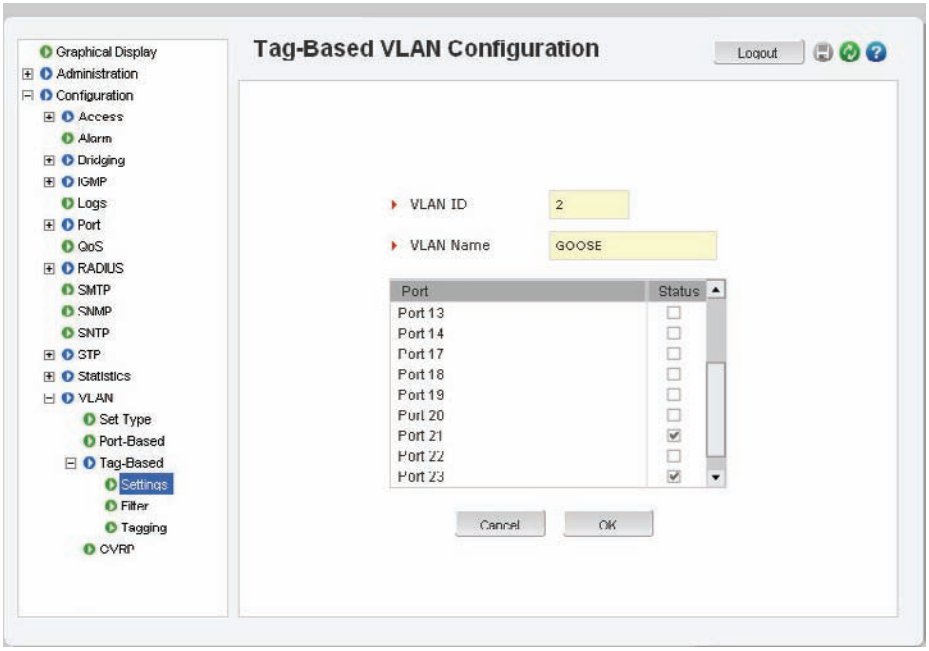
A screen will open that will allow you to configure a new tag based VLAN.

▷ Within this screen enter the new VLAN ID number (or tag) and the name of the VLAN.
We will use a tag of 2 and a VLAN name of GOOSE2.

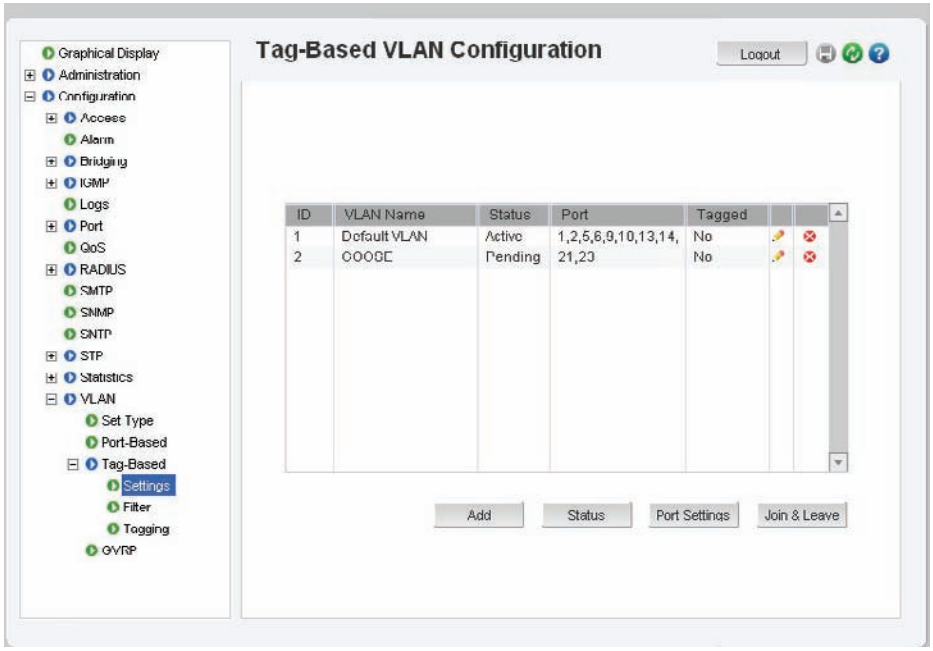
▷ Left mouse click on the check boxes corresponding to ports 21 and 23 to add them to this new VLAN.

▷ Select **Save**.

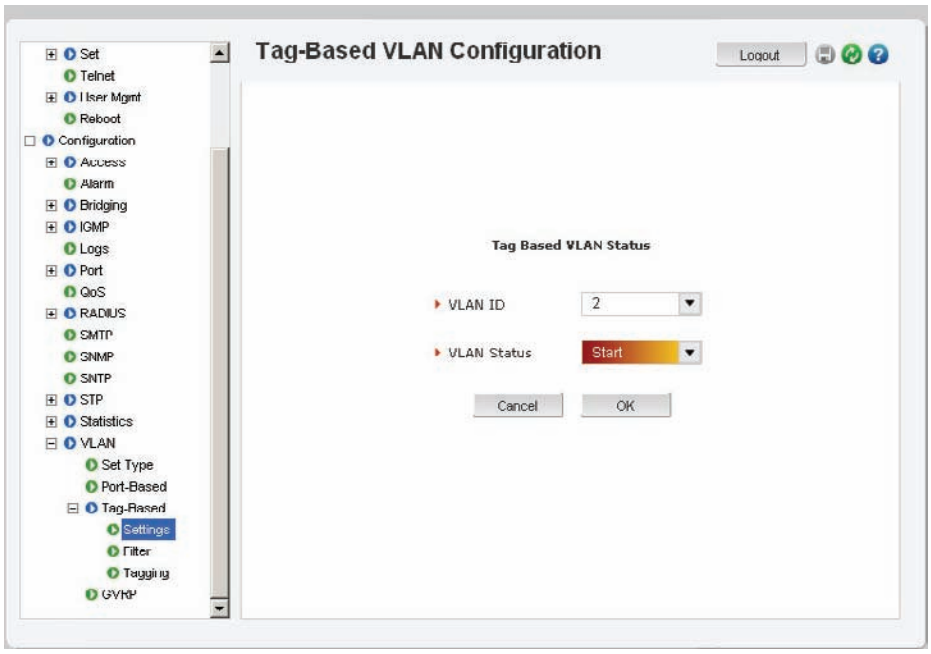
▷ **OK** to exit.



You will notice below, that the status of the VLAN named GOOSE2 is displayed as **Pending**. To activate VLAN 2 proceed as follows.



- ▷ Select **Status**.
- ▷ Once in the Status menu, set the VLAN ID to 2 and the VLAN status to start.



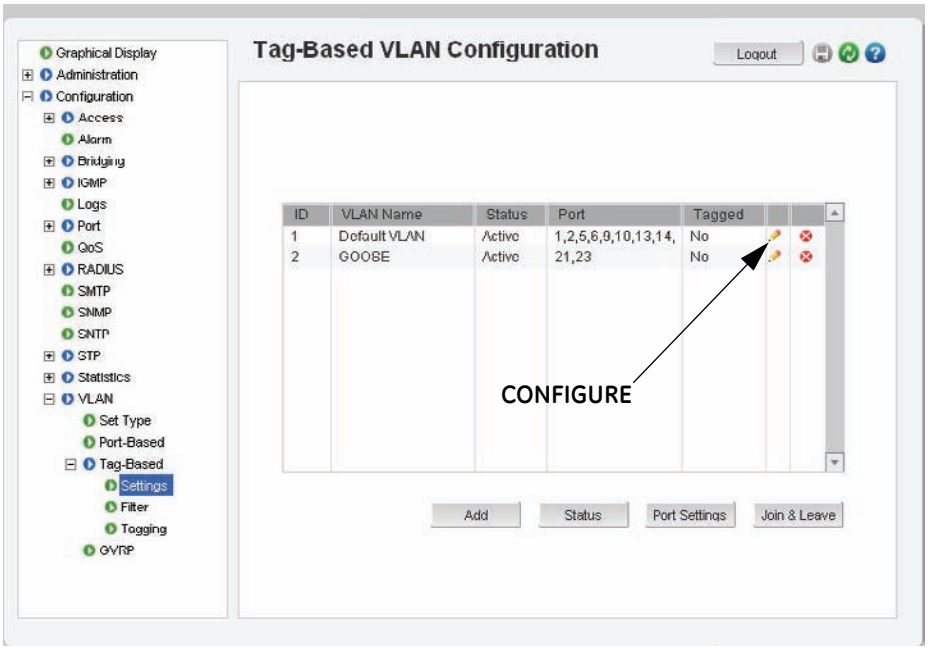
▷ Select **OK** to start VLAN 2.

You will notice that VLAN 2 is now active, and ports 21 and 23 are part of this VLAN. Ports 21 and 23 have been removed from the default tagged based VLAN1.

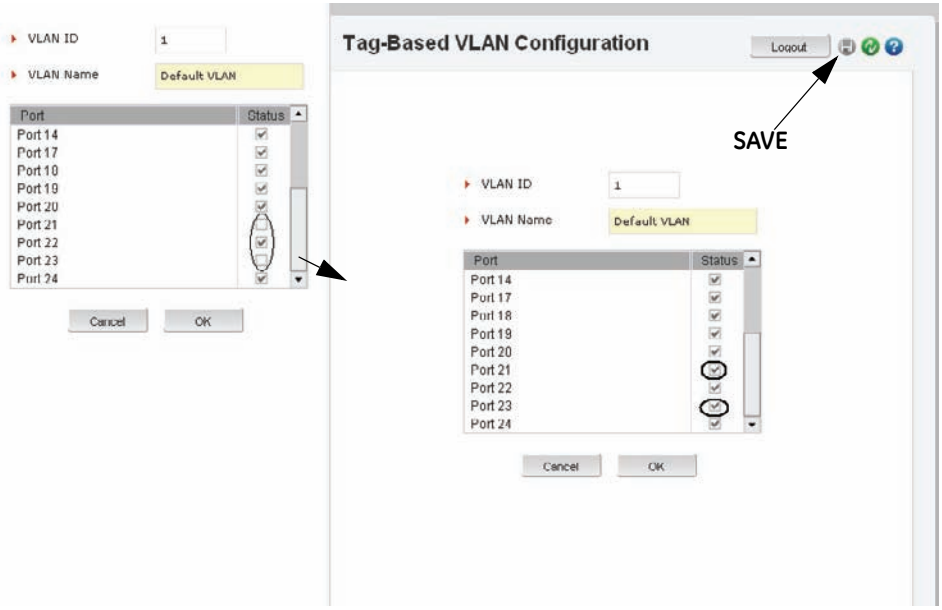
You can add ports 21 and 23 back into the default tagged based VLAN 1 if you wish, such that they are part of both VLAN 1 and VLAN 2.

To do this,

▷ Select the **configure** icon for the default tagged based VLAN1.

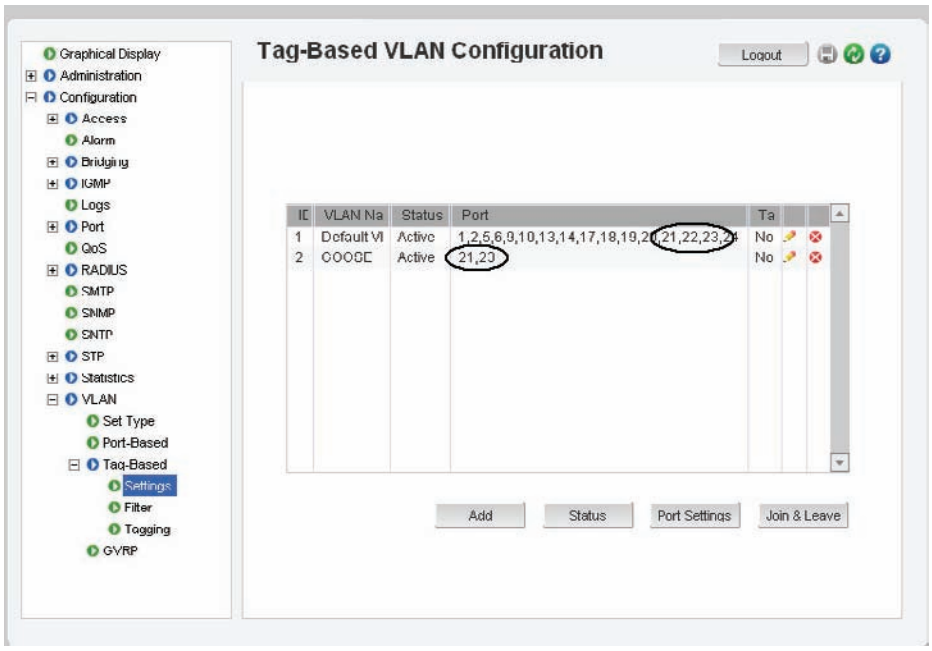


▷ Add ports 21 and 23 to tagged based VLAN 1 by checking the corresponding boxes.



▷ Select the **save** icon at the top of the screen.

▷ Select **OK** to return to the main tag VLAN menu.



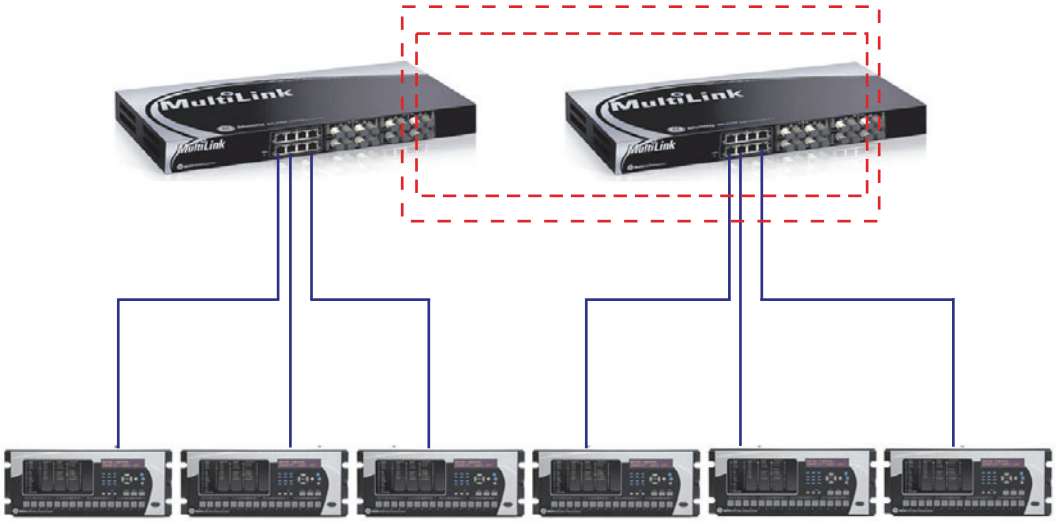
Note that ports 21 and 23 are now part of both VLAN1 and VLAN 2.

You have now completed the exercise.

9.2 Configuring the Multilink switch for Ring Only Mode

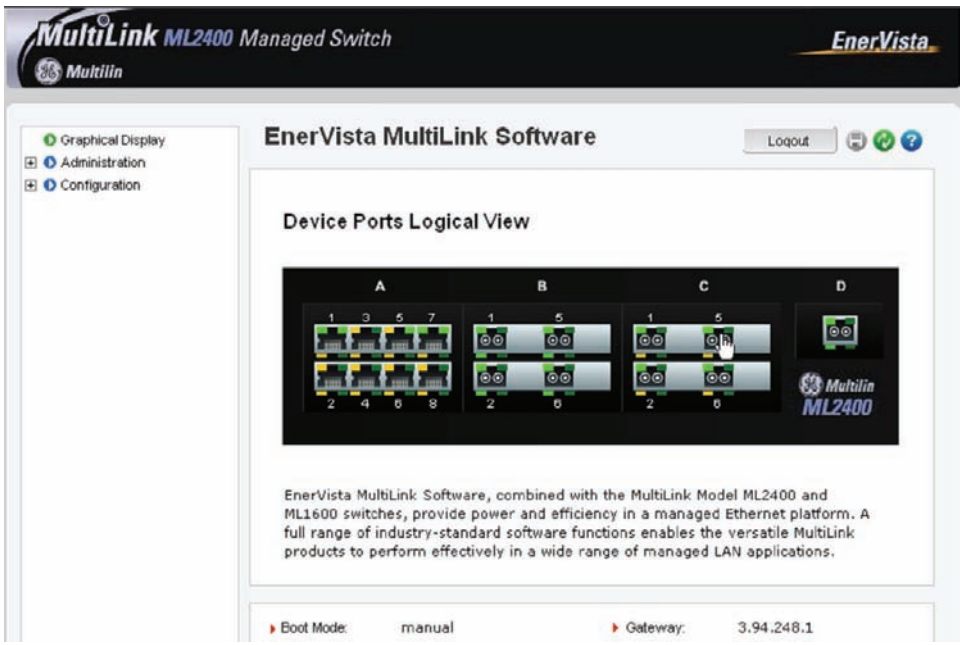
This feature can be only be used when the switches are connected to form a single ring topology which means that only two ports per switch are used to form the ring and all other ports will not be part of another ring. Note that RSTP and Ring-only mode support a maximum of 80 switches. RO mode has typical recovery time of ≤ 5 ms/hop.

▷ Determine which ports on each switch will be used to create the ring.



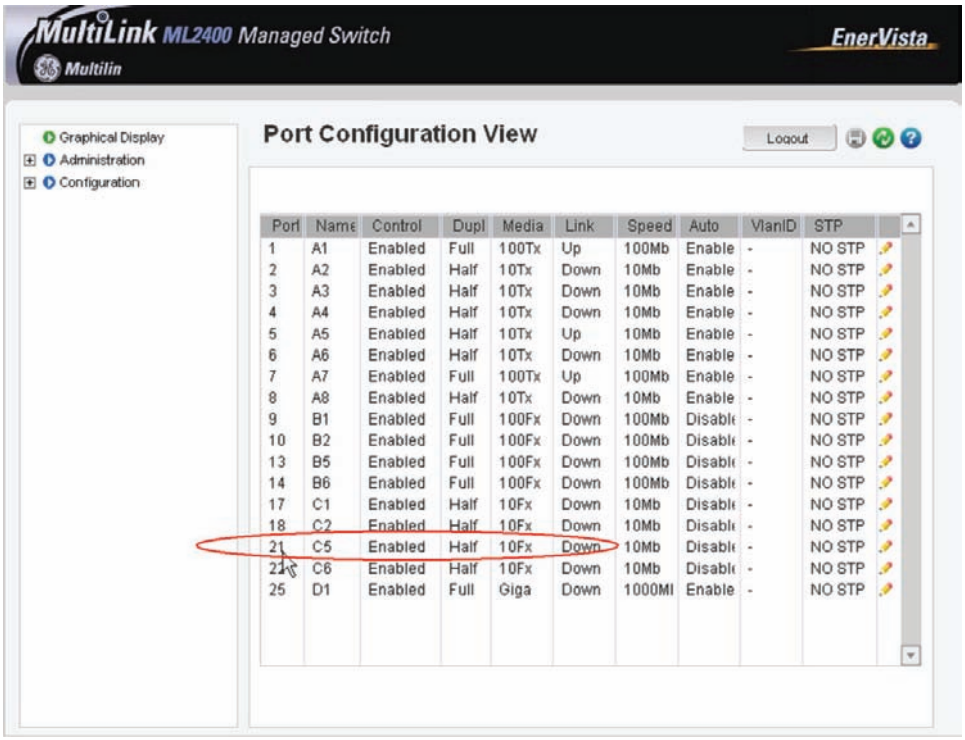
In this example it has been determined that the port named C5 will be one of the ports forming the ring.

▷ Click on the port C5 to open the main port configuration screen.



From this screen we can see that the port named C5 is actually port 21.

▷ Note this port number.



Port	Name	Control	Dupl	Media	Link	Speed	Auto	VlanID	STP
1	A1	Enabled	Full	100Tx	Up	100Mb	Enable	-	NO STP
2	A2	Enabled	Half	10Tx	Down	10Mb	Enable	-	NO STP
3	A3	Enabled	Half	10Tx	Down	10Mb	Enable	-	NO STP
4	A4	Enabled	Half	10Tx	Down	10Mb	Enable	-	NO STP
5	A5	Enabled	Half	10Tx	Up	10Mb	Enable	-	NO STP
6	A6	Enabled	Half	10Tx	Down	10Mb	Enable	-	NO STP
7	A7	Enabled	Full	100Tx	Up	100Mb	Enable	-	NO STP
8	A8	Enabled	Half	10Tx	Down	10Mb	Enable	-	NO STP
9	B1	Enabled	Full	100Fx	Down	100Mb	Disable	-	NO STP
10	B2	Enabled	Full	100Fx	Down	100Mb	Disable	-	NO STP
13	B5	Enabled	Full	100Fx	Down	100Mb	Disable	-	NO STP
14	B6	Enabled	Full	100Fx	Down	100Mb	Disable	-	NO STP
17	C1	Enabled	Half	10Fx	Down	10Mb	Disable	-	NO STP
18	C2	Enabled	Half	10Fx	Down	10Mb	Disable	-	NO STP
21	C5	Enabled	Half	10Fx	Down	10Mb	Disable	-	NO STP
22	C6	Enabled	Half	10Fx	Down	10Mb	Disable	-	NO STP
25	D1	Enabled	Full	Giga	Down	1000MI	Enable	-	NO STP

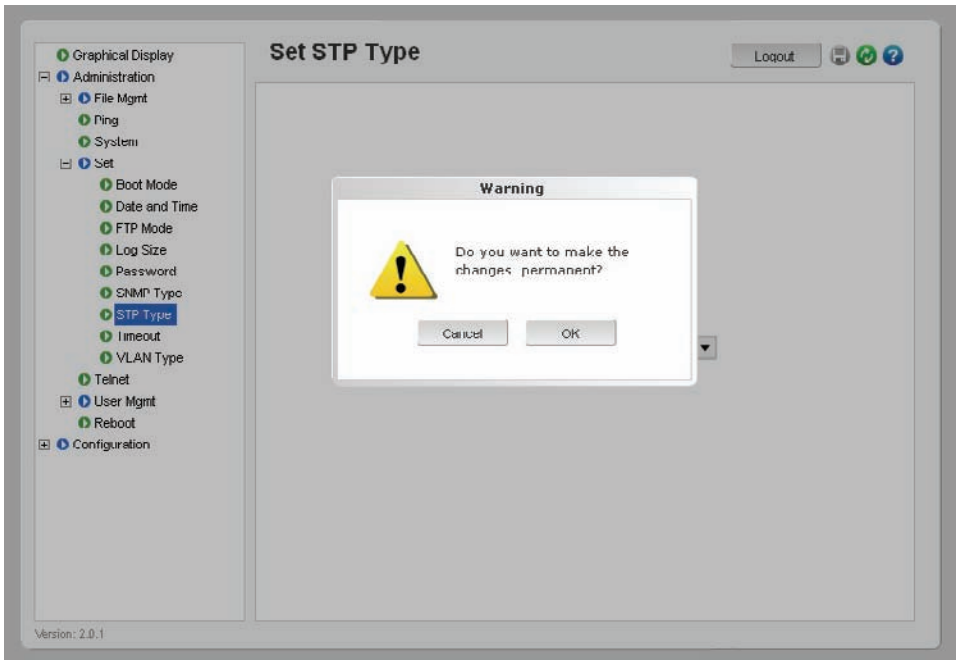
▷ from the Administration menu open the **Set** menu.

▷ Open the **STP type** setting.

▷ Set STP to Rapid Spanning Tree (**RSTP**).

▷ **Save** the setting.

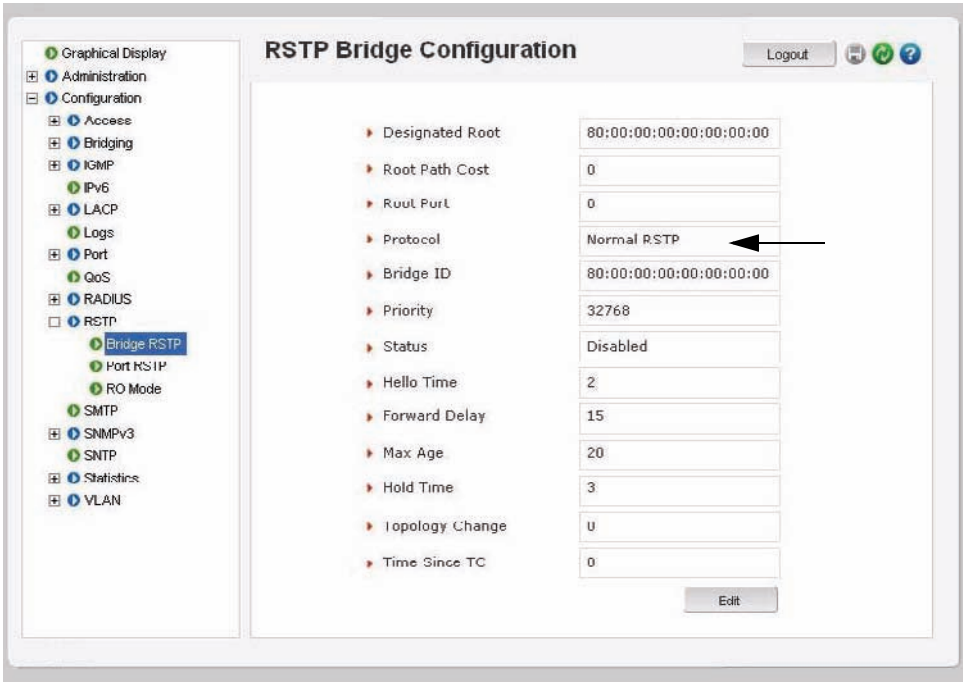
.

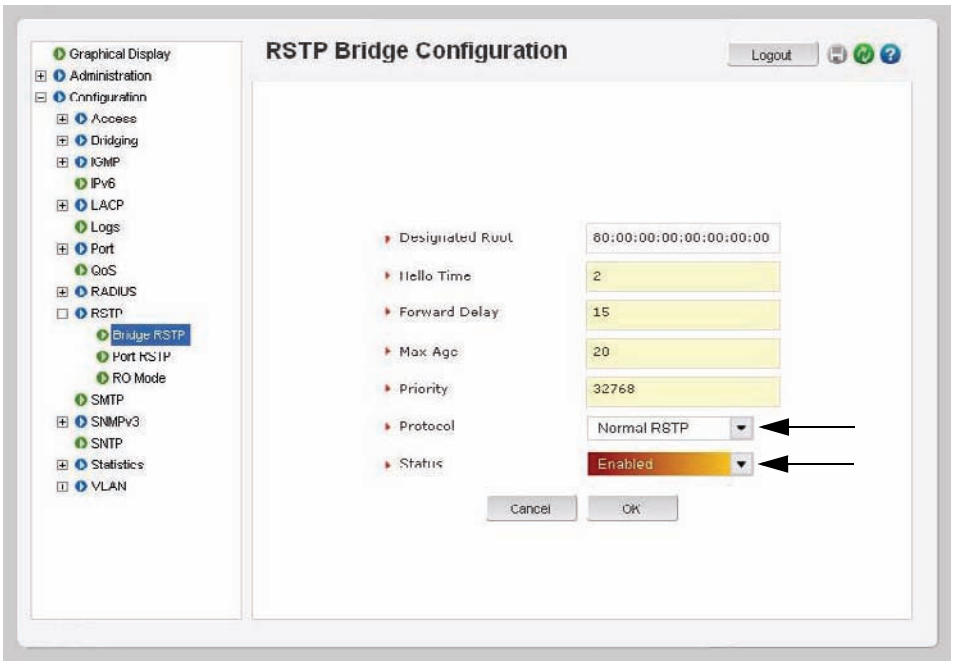


▷ From the configuration menu open the **RSTP** menu.

▷ Select **Bridge RSTP**.
Note that the protocol is still set to **normal RSTP**.

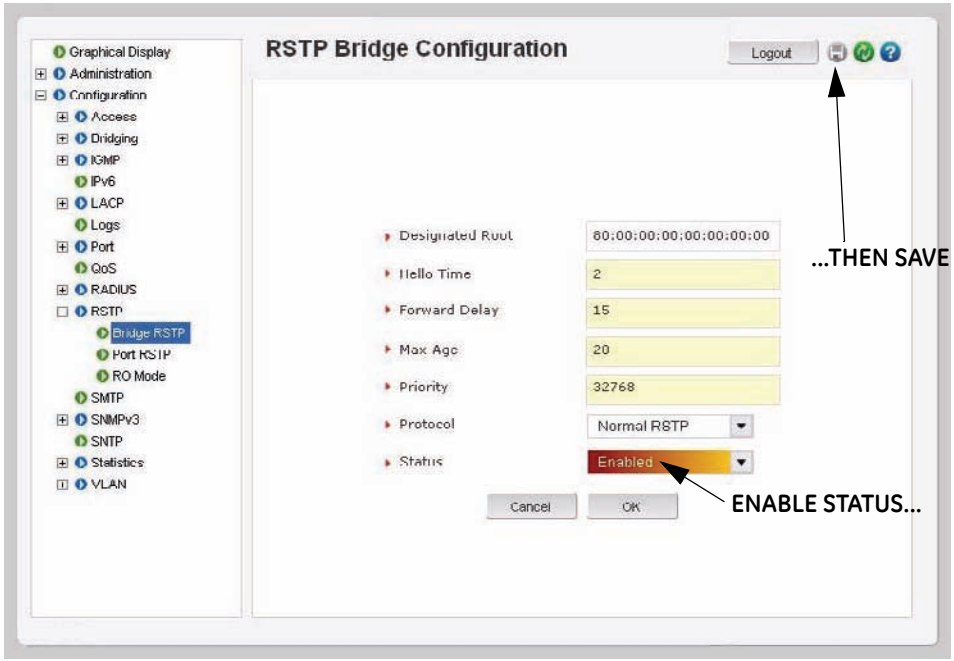
▷ Select the **Edit** icon.



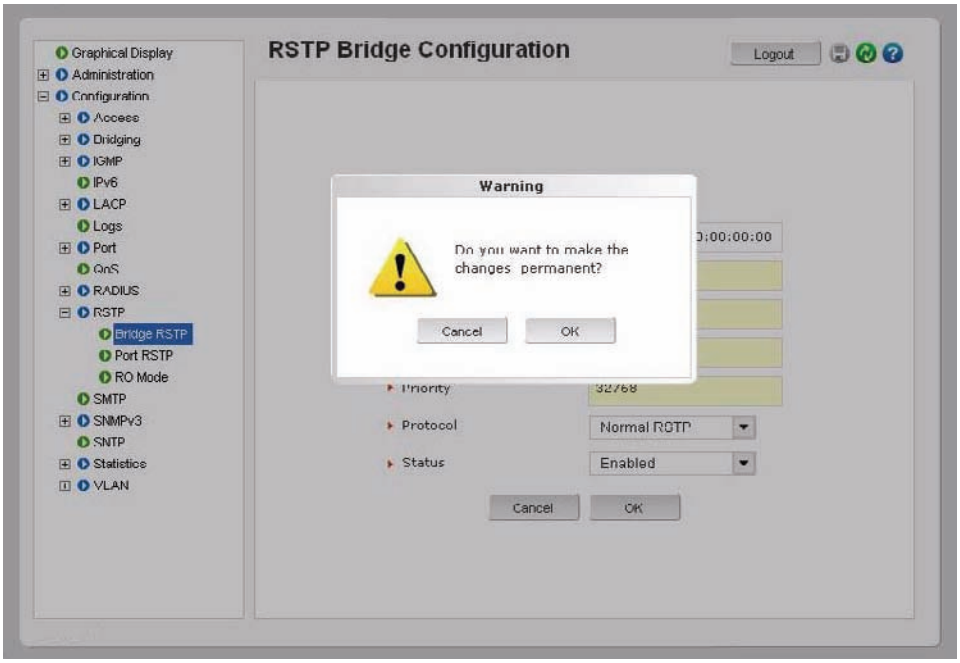


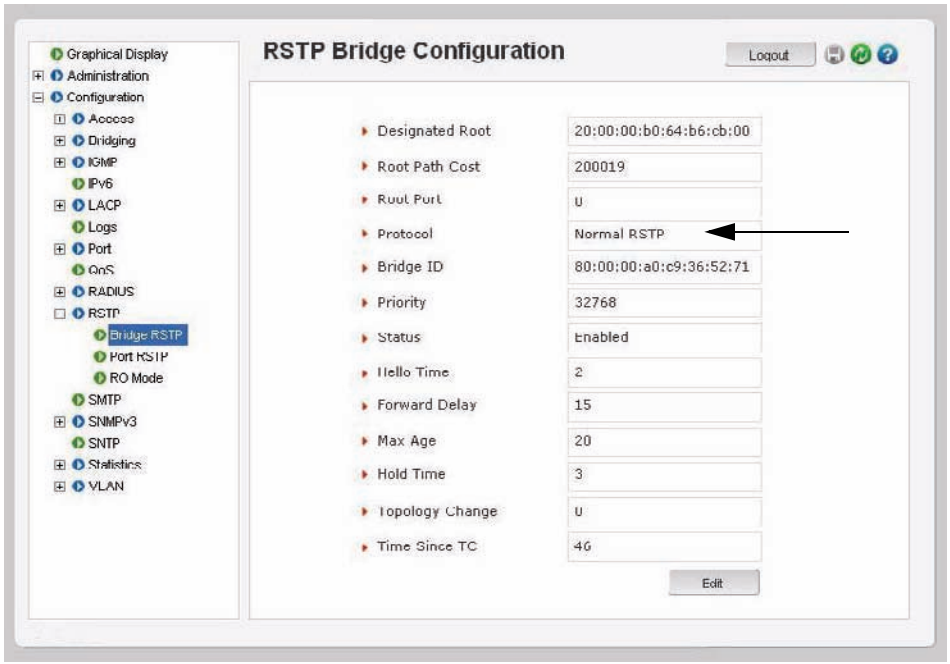
▷ Once in **Edit** mode, change the **Status** to **Enabled**

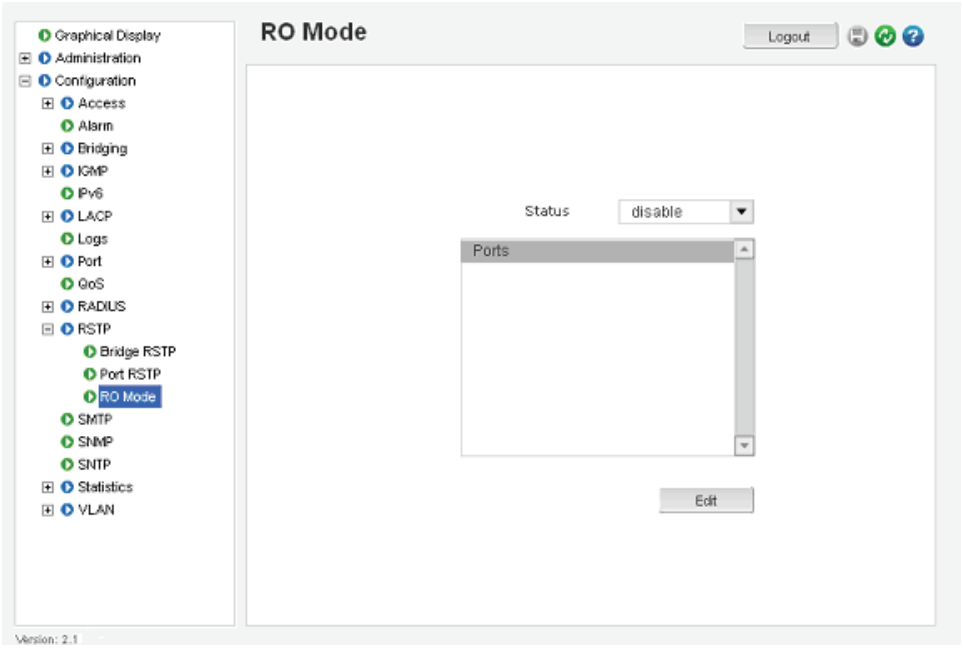
▷ Once these settings have been completed **Save** the configuration.



▷ Once saved, select **OK**, then **OK** again to exit.

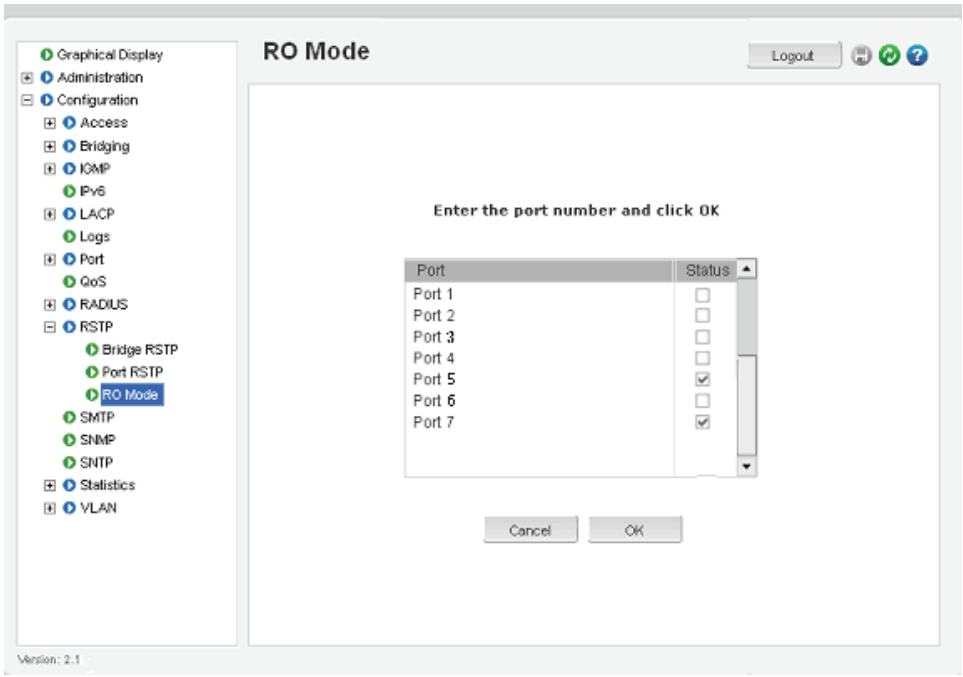




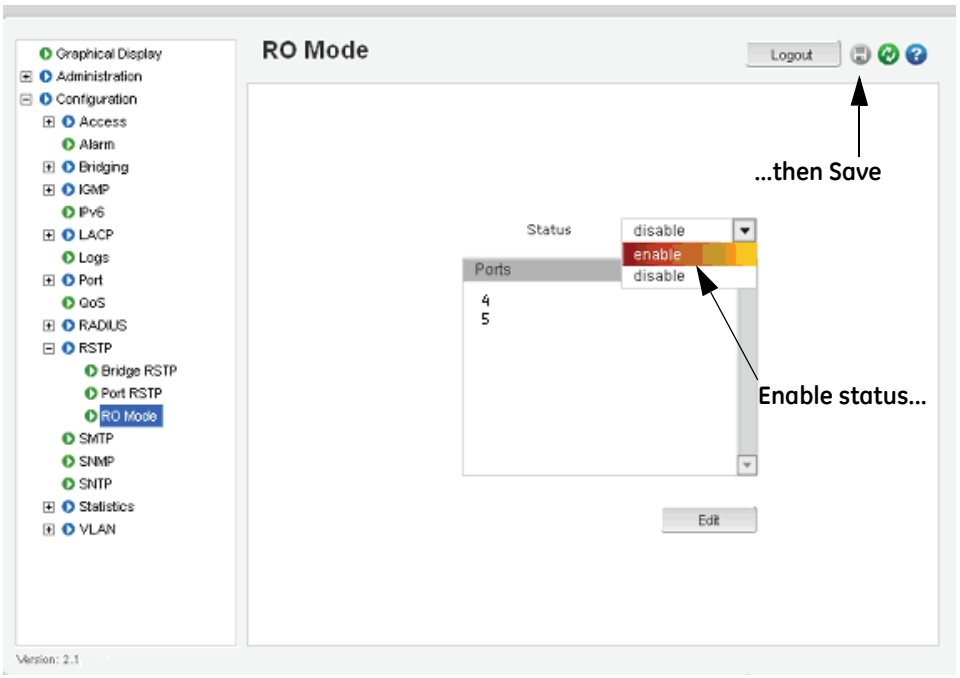


- ▷ Select the **Configuration > RSTP > RO Mode** menu as shown above.
- ▷ Click the **Edit** button to configure RO Mode.
- ▷ Select the desired ports that are part of the ring, as shown below.
- ▷ Click **OK** to exit.

Only 2 ports can be selected to Ring Only Mode.



▷ Select the **Enabled** option for the Status setting as shown below.

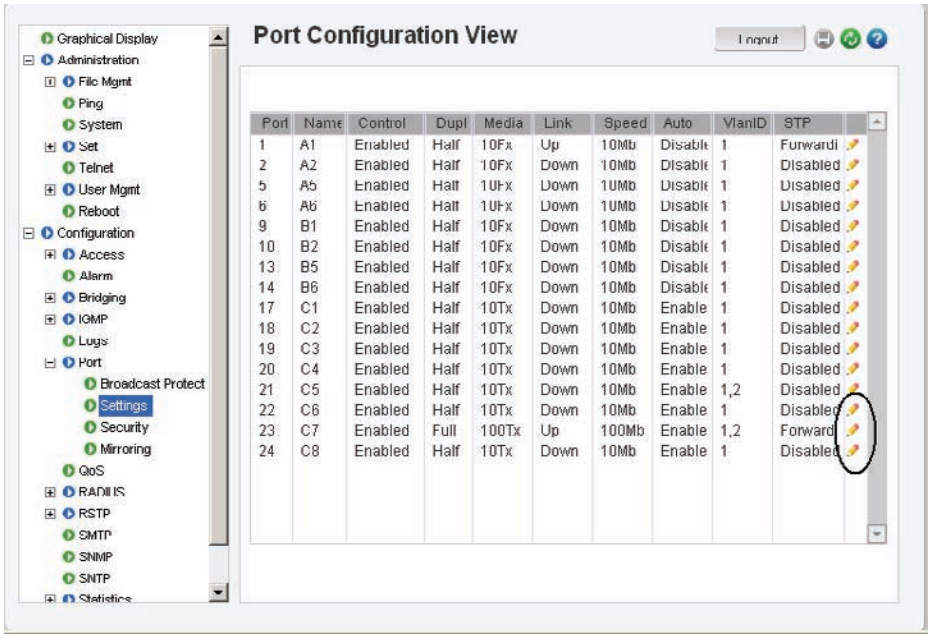


▷ Change status to **Enable**.

▷ Save the configuration by clicking on the icon.

For proper recovery, disable the **Link Loss Alert** function on the port named C5 (port21) as follows:

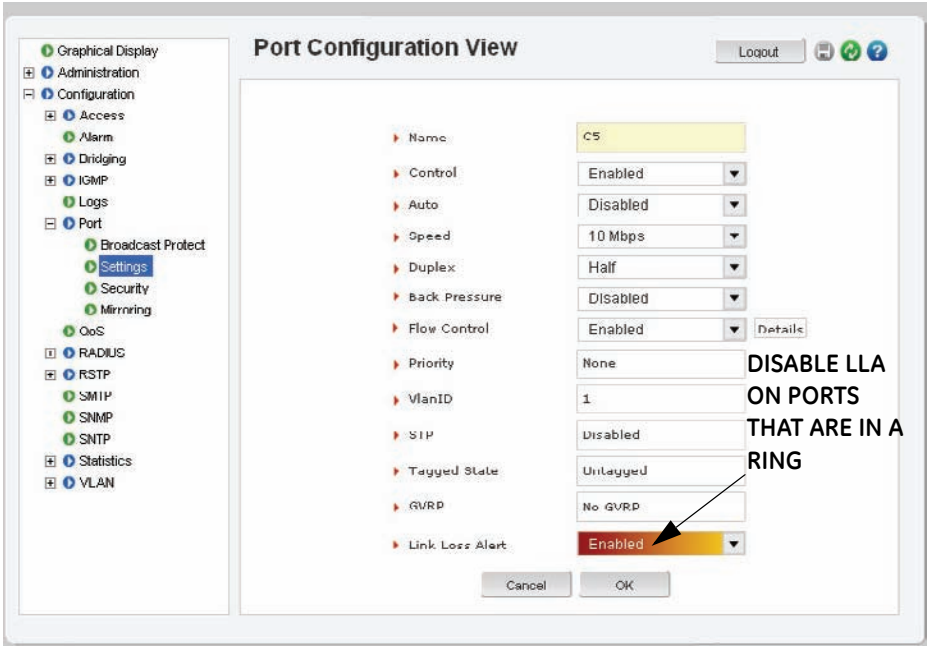
▷ From the main port configuration menu, left mouse click on the **Configuration** icon for port 21.



▷ Within port 21's configuration screen set the Link Loss Alert to **Disabled**.

▷ **Save** the settings.

▷ Repeat this procedure for the other port on this and the rest of the switches that form the ring.



▷ Once this procedure has been completed for all ports forming the ring, connect the configured ports into the ring topology as shown below.

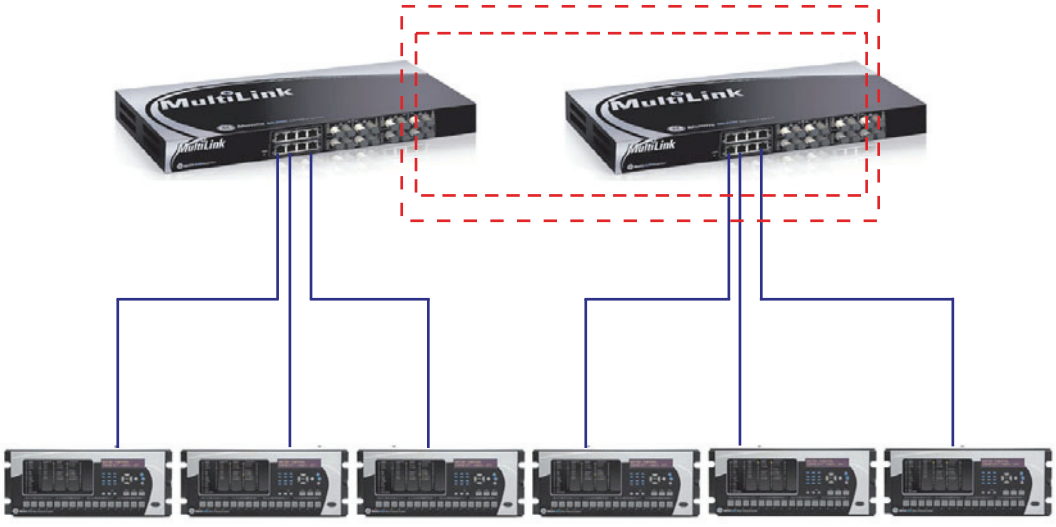


FIGURE 16: Configuration of the MultiLink ring Only mode

You have completed the exercise.

10 Multilink Firmware Updates

10.1 Updating MultiLink Firmware

This section describesthe process for upgrading the firmware on a GE Multilink Ethernet switch. The methods describe updating the Multilink firmware either locally using the console port or remotely over the network using FTP or TFTP.

The following equipment and software are required for loading the Multilink Ethernet switch with the new firmware version.

1. A female-to-female null modem cable. (This is only necessary when upgrading using the Multilink console port.)
2. PC serial port. If your PC does not have a serial port, a USB-to-serial converter will be required. (This is only necessary when upgrading using the Multilink console port.)
3. A PC (or a workstation/computer) with a terminal emulation program such as Huyperterminal (included with Windows) or Teraterm-pro or other equivalent software. Verify that the software supports Xmodem protocol.
4. Enough disk space to store and retrieve the configuration files as well as a copy of the Multilink firmware. We recommend at least 15 MB of free disk space.
5. Manager level account name and password for the switch being upgraded.
6. An internet connection. Ensure the connection does not block ftp file transfers

10.2 Selecting the Proper Version

The latest version of the firmware is available at:

http://www.GEmultilin.com/catalog/ethernet.htm.

To determine the version of firmware currently installed on your switch, do the following:

- ▷ Using the command line interface, log into the switch uwing **Manager** access rights.
- ▷ In the command line prompt, enter the command, **show version**.
- ▷ Using the EnerVista web interface, enter the IP address of the switch in the address bar of a web browser
  The firmware version installed on the switch will appear in the lower left corner of the screen.

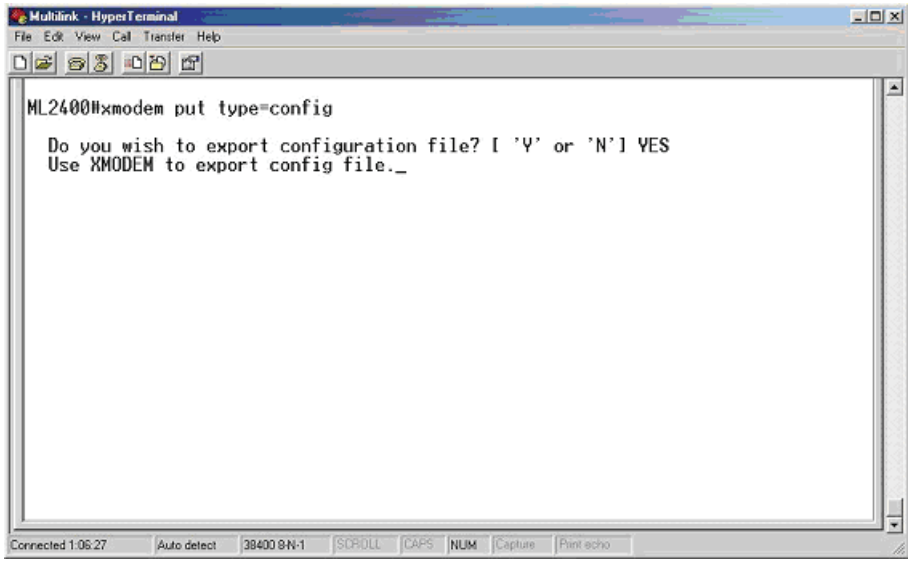
10.3 Upgrading Using a Serial Connection- Command Line Interface

Use the following procedure to install firmware to the MultiLink Ethernet Switch via the serial port.

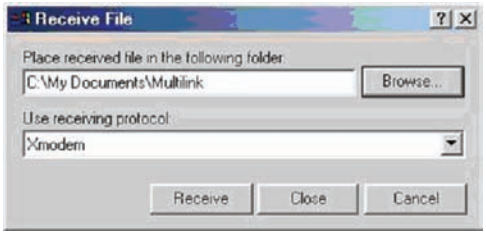
- ▷ Download the MultiLink Switch Software from the GE Multilin web site, to a convenient location on your hard drive.
- ▷ Use the null-modem cable to connect to the serial port of the switch.
- ▷ Login at the **manager** level with the proper password.

It is recommended that you save the current switch configuration before upgrading the firmware.

▷ Enter the **xmodem** command as shown below:

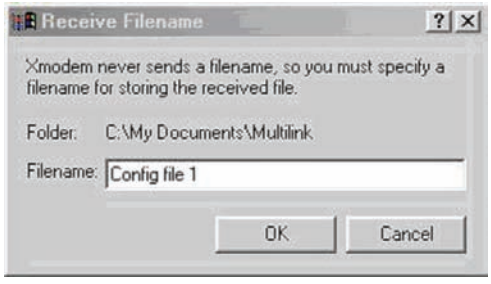


▷ Click on the **Transfer** menu item and choose the **Receive File** option.



▷ Enter the path to the folder in which the configuration file will be stored

▷ Select Xmodem as the receiving protocol.



▷ Enter a name for the configuration file.

▷ Click **OK**.
The configuration file will be stored at the specified location.

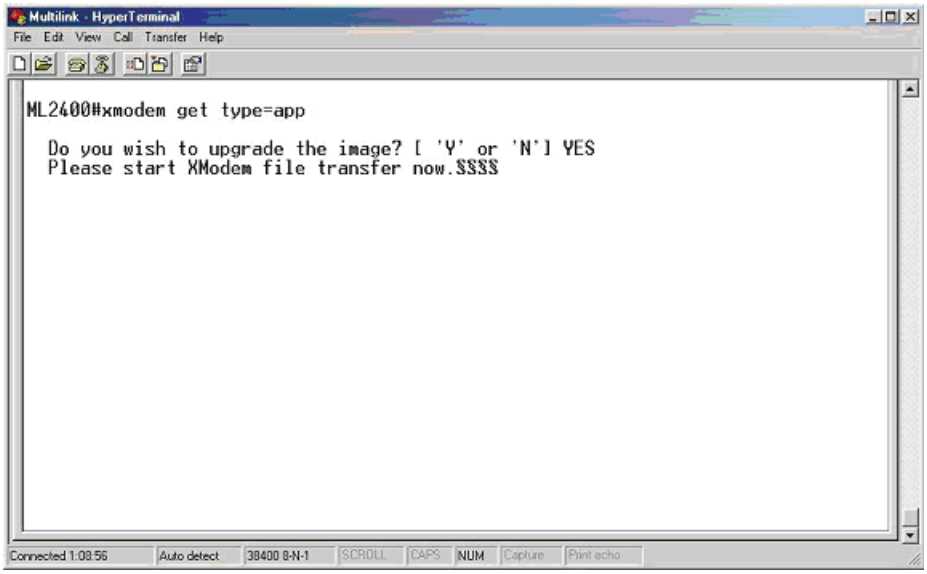
▷ Verify that the configuration file has been created and stored correctly.

This completes the Save (original) Configuration procedure.

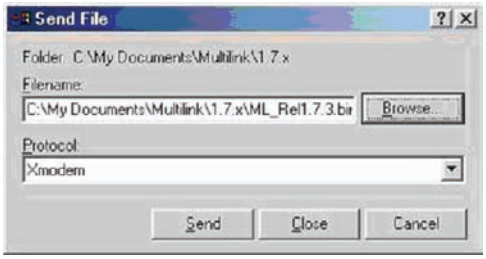
The following procedure describes how to upgrade the firmware:

▷ Use the **xmodem** command:

```
ML800/1200/1600/2400# Xmodem get type=app
Do you wish to upgrade the image? [Y or N]  Y
```



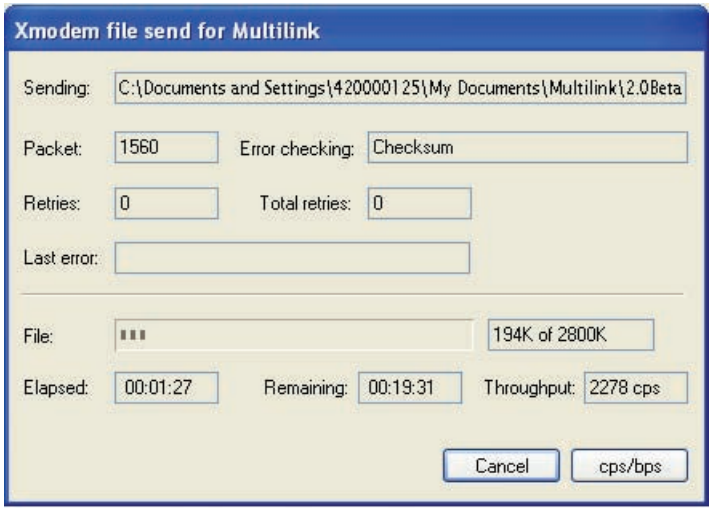
▷ Select the **Transfer** menu item and choose the **Send File** option



▷ Enter the location of the firmware file that has to be loaded into the switch.

▷ Select **Xmodem** as the protocol.

▷ Click on the **Send** button.
The file will start to load as shown below.



▷ Once the file transfer is complete, reboot the switch using the **Reboot** command, or by switching the power off then on.

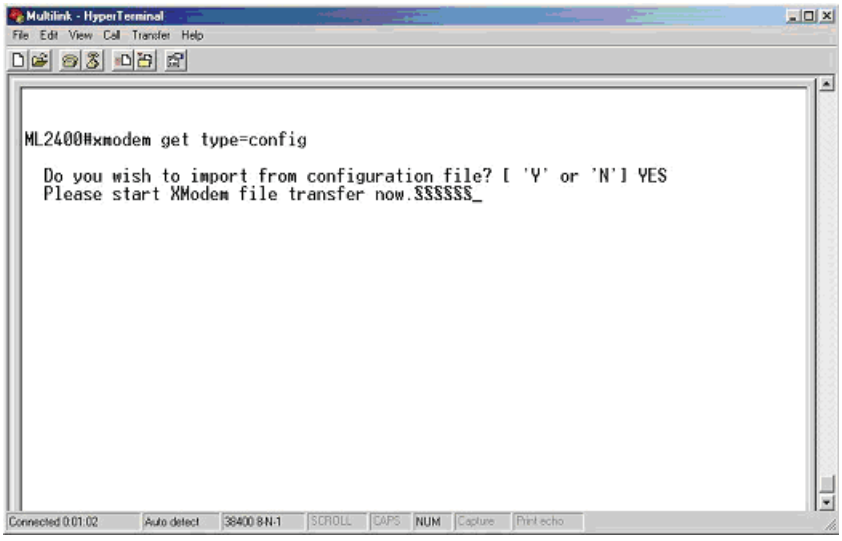
```
ML800/1200/1600/2400# reboot

   Proceed on rebooting the switch? [Y or N] Y

Rebooting now...
```

▷ Login to the switch and use the **show version** command to verify the version.

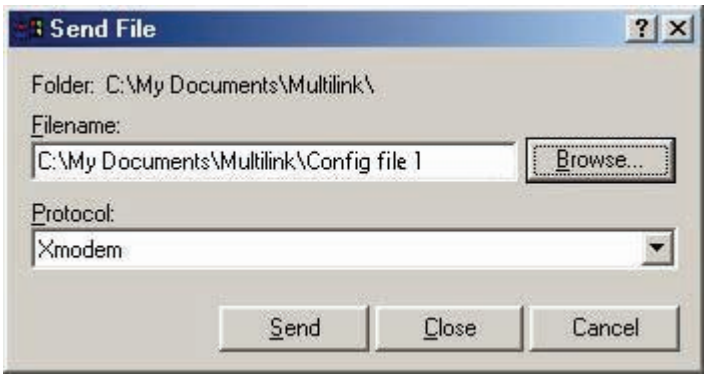
```
ML800/1200/1600/2400# show version
```

▷ If necessary, upload the configuration file using the following commands.

▷ Enter the **xmodem** command as shown below:

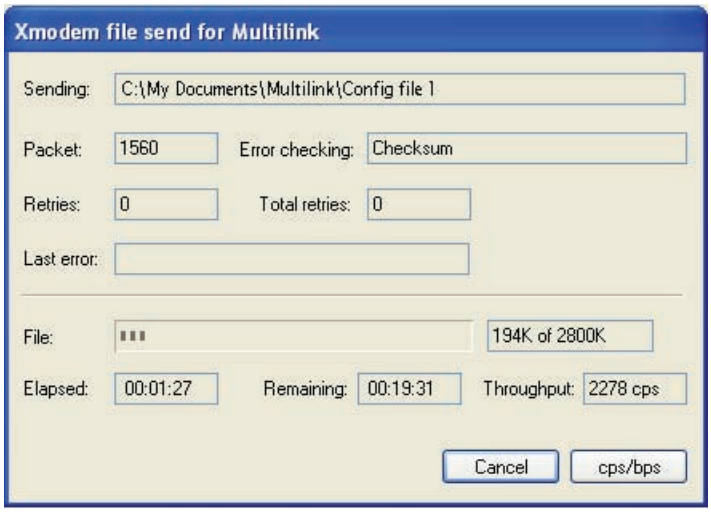


▷ Select the Transfer menu item and choose the **Send File** option.



▷ Enter the location of the configuration file and select Xmodem for the protocol.

▷ Click on the Send button.
The file will start to load as shown below:



▷ Once the transfer is complete, the switch will have to be rebooted either by entering **Reboot** or by switching the power off then on.

```
ML800/1200/1600/2400# reboot

   Proceed on rebooting the switch? [Y or N] Y

Rebooting now...
```

▷ Once the switch has rebooted, login and verify that the configuration was loaded correctly.

This completes the upgrade process.

10.4 Updating Using the EnerVista Web Interface Software

Use the following steps to install the EnerVista Secure Web Management software.

- ▷ Download the latest MultiLink firmware from the GE Multilin web site to a convenient location on your hard drive.
- ▷ Ensure that you have an FTP or TFTP server installed and running on your computer. If you are using FTP, make sure you have the FTP login name and password information ready.
- ▷ Select the switch to upgrade. Ensure you have system administration rights and privileges available on that switch.
- ▷ Open a SWM session with the switch by typing in the following URL:

  https://<IP address of the switch>

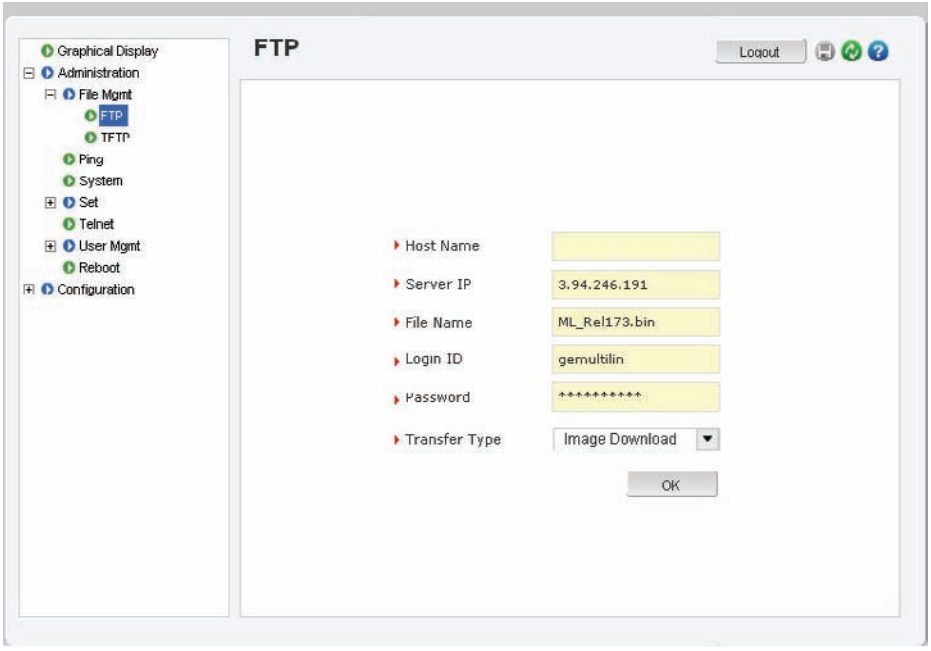
10.4.1 Using FTP

It is always a good idea to save the configuration before an upgrade. GE Multilin recommends a two-step update: first save the configuration to the ftp server, then load the new image and restart the switch.

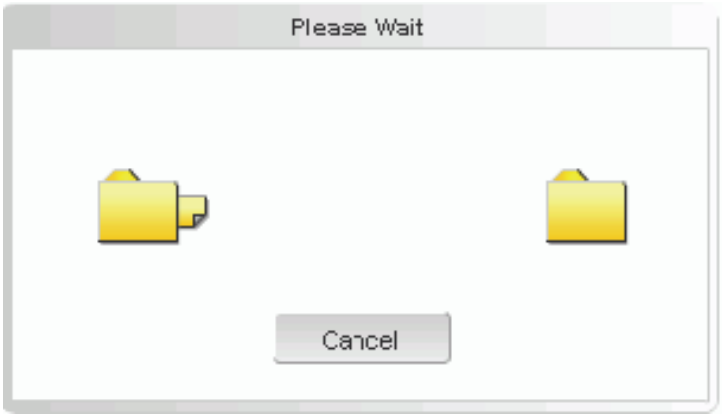
To save the configuration using FTP,

- ▷ Select the **Config Upload** transfer type in the FTP window
- ▷ Load the new firmware as shown below

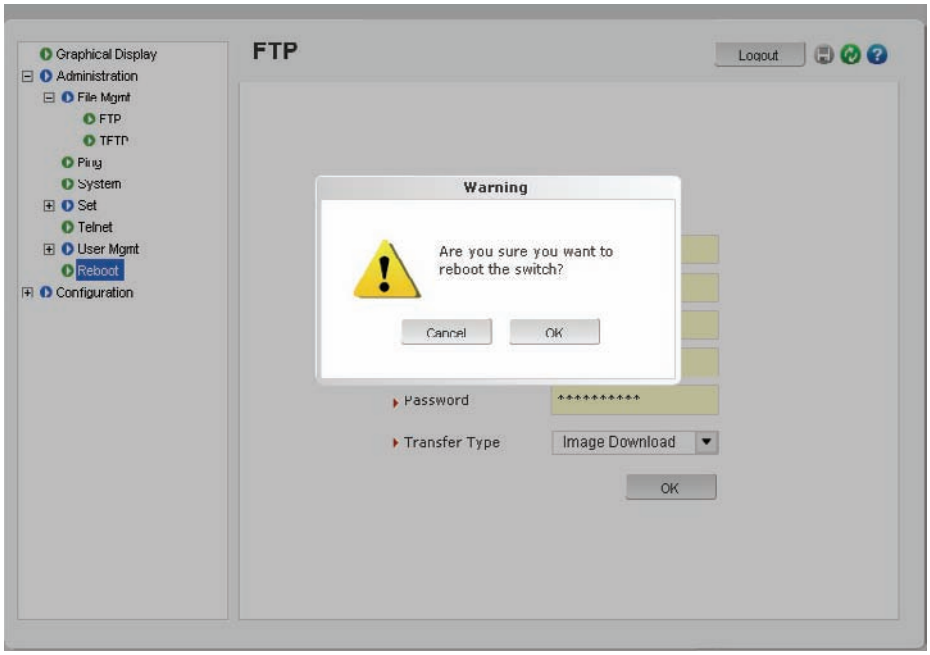
FTP is located under **Configuration > File Mgmnt > FTP,** if the current firmware is older than 1.7.3..



As the file is being loaded, you will see the **file transfer in progress** window.



▷ Once the transfer is complete, the switch needs to be restarted.



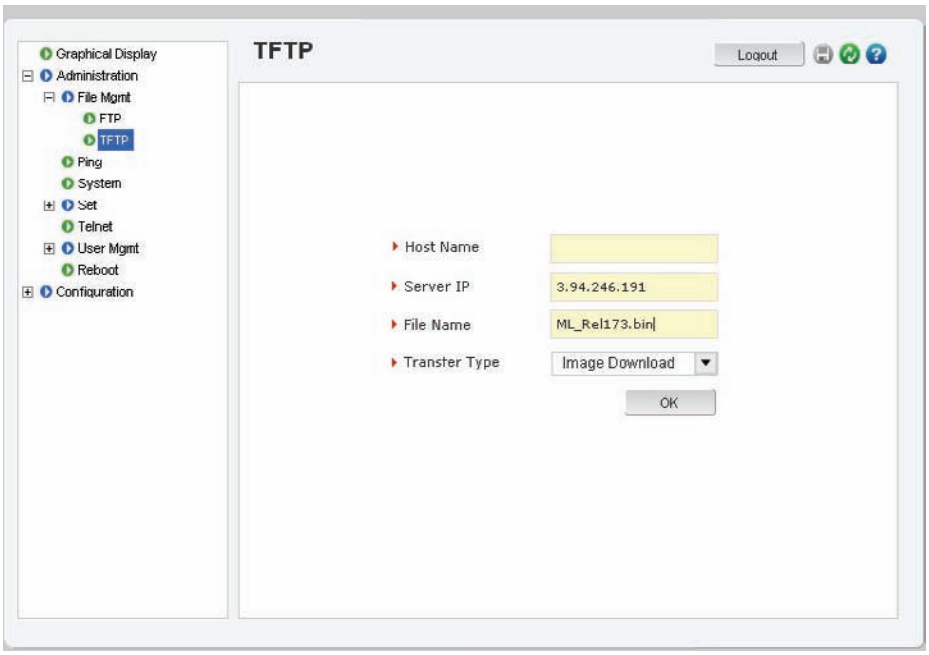
After reboot, the new version of the Multilink firmware is ready for use.

10.4.2 Using TFTP

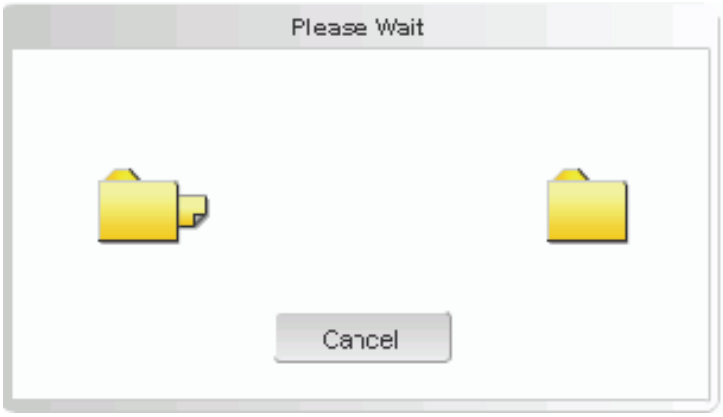
It is always a good idea to save the configuration before an upgrade. GE Multilin recommends a two-step update: first save the configuration to the ftp server, then load the new image and restart the switch.

▷ Load the new firmware as shown below.

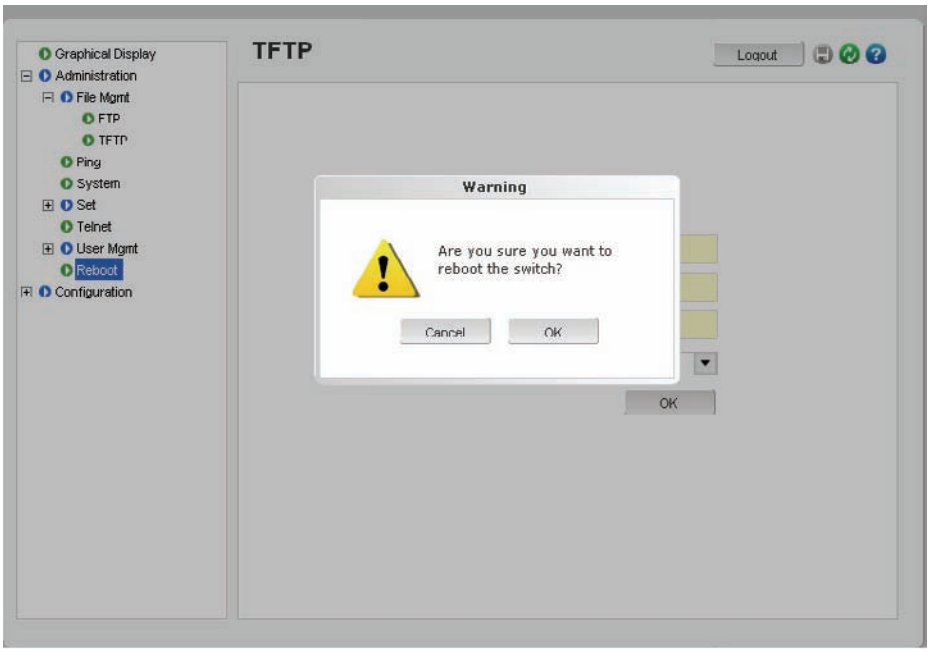
FTP is located under **Configuration > File Mgmnt > TFTP,** if the current firmware is older than 1.7.3.



As the file is being loaded, you will see the **file transfer in progress** window.



▷ Reboot the switch when the transfer is complete.



After reboot, the new version of the Multilink firmware is ready for use.